BACTERIOLOGICAL WATER QUALITY OF THE DETROIT RIVER, ST. CLAIR RIVER, 1973

Ministry of the Environment
Ontario

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Minister

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BACTERIOLOGICAL WATER QUALITY OF THE ST. CLAIR RIVER 1973

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ABSTRACT

Surveys were conducted during May, June, August and October 1973 on the St. Clair River. Determinations were made of the concentrations of Total Coliforms, Fecal Coliforms and Fecal Streptococci.

The results demonstrated low bacterial levels in May with some increase in counts in June. During the June survey, high TC levels were determined to exist near Sarnia, Marysville and Port Lampton. Further water quality deterioration occurred in August particularly on the Canadian side where TC densities were high along the entire shoreline below Sarnia. High TC concentrations were also found near Marysville in combination with high FC levels. In October, there was a further decline in water quality on the Canadian side but the reverse was true along the American side.

INTRODUCTION

The St. Clair River (Figure 1) is the interconnecting waterway between Lake Huron and Lake St. Clair. It is moderately industrialized on both the American and Canadian shores. The Sarnia, Ontario area is quite heavily industrialized, having numerous oil refineries and chemical plants.

The river is important as a major shipping route for commercial vessels travelling though the Great Lakes system. It is also used for sport fishing, boating and for municipal water supplies.

Four surveys were carried out in May, June, August and October 1973 as part of the Ministry of the Environment's monitoring survey program. Included in the overall studies were determinations of the levels of three bacteriological parameters; Total Coliforms (TC), Fecal Coliforms (FC) and Fecal Streptococci (FS).

METHODS

Field Procedures

The May survey consisted of daily bacteriological sampling at each of forty-two sampling points (Figure 2) located along the full length of the river, with the procedure repeated on three consecutive days.

The June, August and October surveys consisted of a repetition of the May study.

All bacteriological samples were surface samples collected at one meter below the surface using a sterile 237 ml rubber air syringe connected to a modified piggyback sampling device. After collection the samples were transported, on ice, to the MOE London laboratory for analysis within twenty-four hours.

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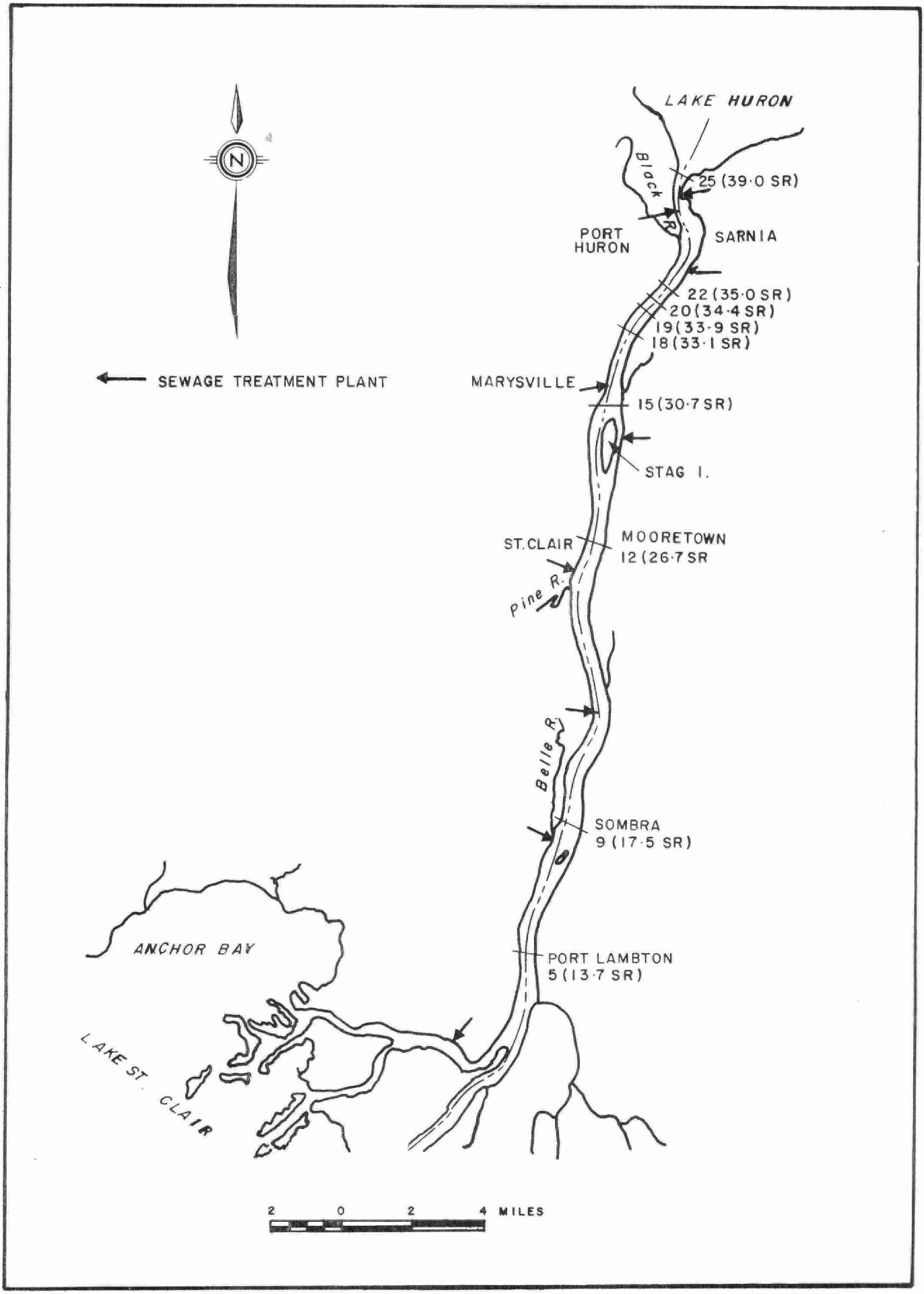

FIGURE 1: ST. CLAIR RIVER SURVEY AREA 1973 – STATION TRANSECT LOCATIONS

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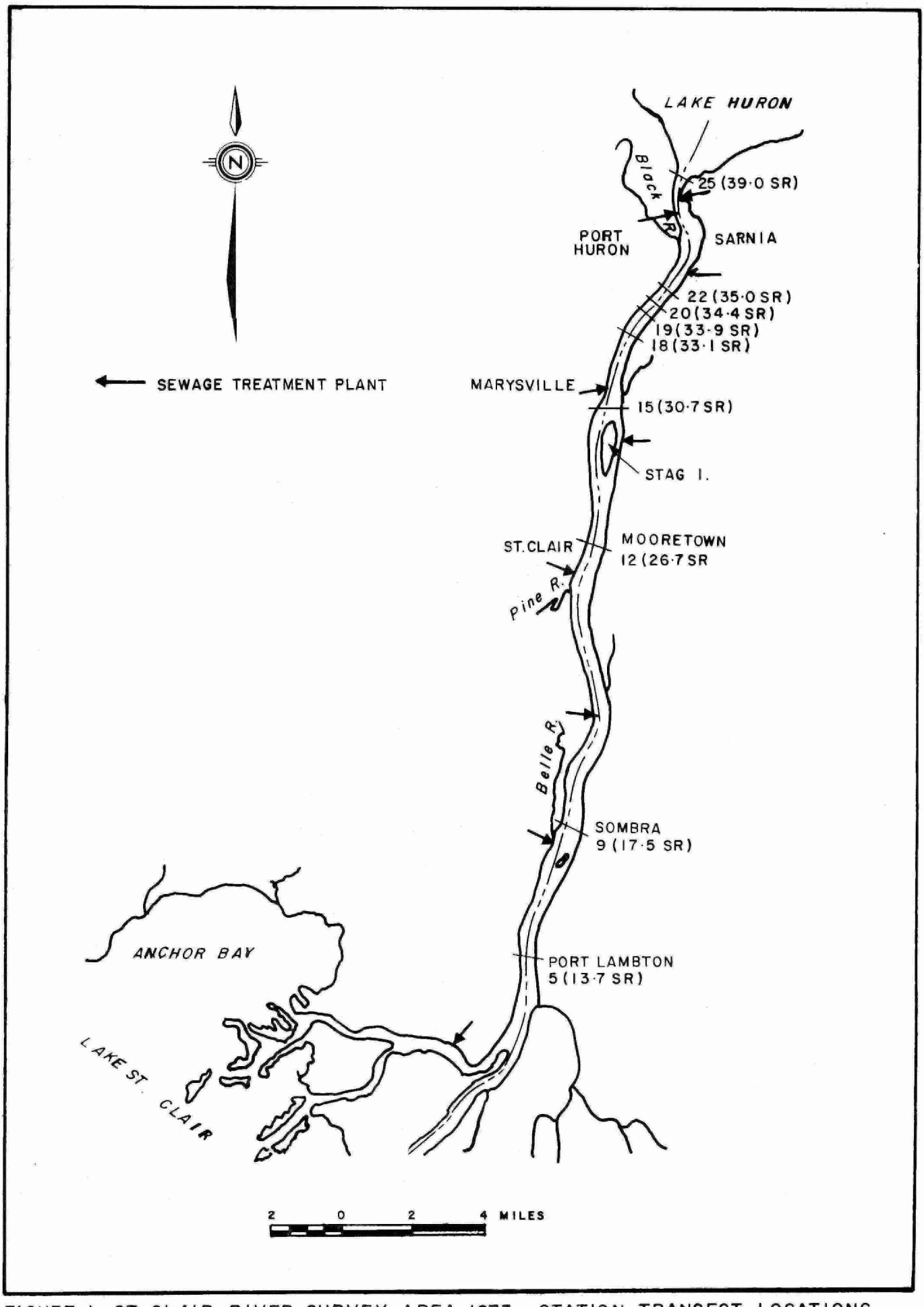

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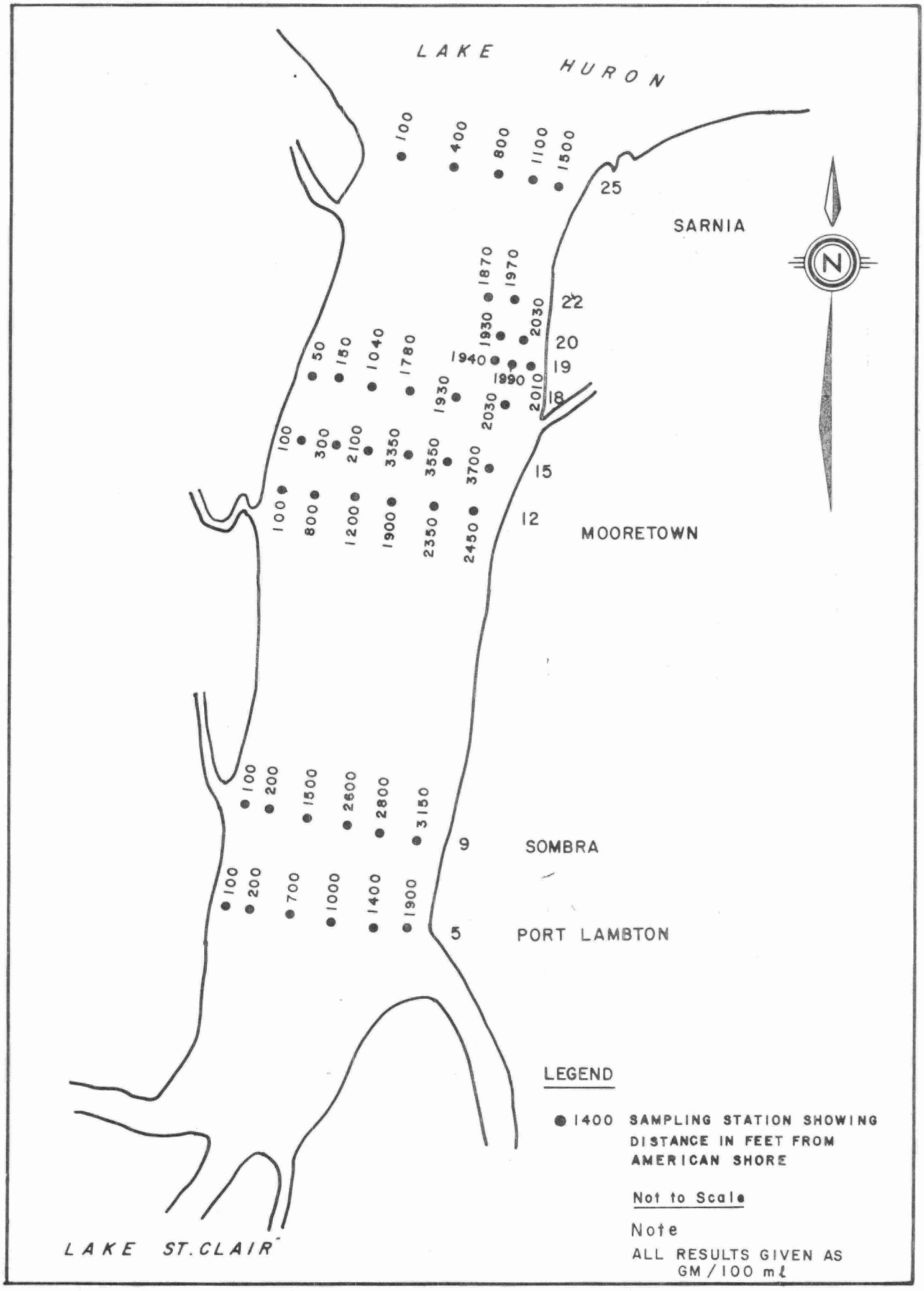

FIGURE 2 : ST. CLAIR RIVER SURVEY AREA 1973 — STATION LOCATIONS

Laboratory Procedures

All samples were analyzed for Total Coliforms (TC), Fecal Coliforms (FC) and Fecal Streptococci (FS). Membrane filtration analyses were conducted according to Standard Methods (13th edition) using m-Endo Agar LES (Difco) for TC, MacConkey Membrane Broth (Oxoid) for FC, and m-Enterococcus Agar (Difco) for FS.

Statistical Methods

Fluctuations in bacterial concentrations due to changing environmental conditions require that a great number of samples be taken to arrive at a mean value which is representative of a specific sample location or sampling area. The most appropriate mean for bacterial levels and this type of data is the geometric mean (GM). The large amounts of bacteriological data generated from this survey necessitated statistical methods to summarize the results concisely and to facilitate an unbiased interpretation.

For each survey, the daily results for each parameter were organized as replicate results for each station. The log geometric mean, the variance, and the standard error were then calculated for each parameter at each station.

Once the station group statistics had been obtained, an analysis of variance program (ANOVA) was used to group the stations into areas within the same statistical bacterial level. The ANOVA analysis was first performed on all survey stations. If the calculated F-ratio was less than the critical F-ratio (0.05 level), the stations were considered statistically the same and were summarized as a group with one set of overall group statistics. At the same time as the ANOVA analyses were performed, the homogeneity of the variances was also checked using Bartlett's X^2 test of homogeneity. If either the F or X^2 was significant, indicating a non similar grouping, stations that were judged to be significantly different, based on a statistical curcumspection of the data, were tested and, if necessary,

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eliminated until both the F-ratio and X^2 were nonsignificant. The withdrawn stations were regrouped with respect to geographic proximity. The calculations on all groups were repeated using the ANOVA program until each discrete group was homogeneous. The Student-t-test (using the log GM and S.E.) was used to compare overlapping homogeneous areas between each of the survey.

CRITERIA

The Ontario Ministry of the Environment (MOE) Bacterial Criteria for various water uses are presented in Table 1. One of the prime reasons for inclusions of bacteriological parameters in water quality analysis is to indicate the presence of fecal contamination and thus the possible presence of pathogenic bacteria. Since the determination of specific pathogens in water is generally slow, laborious and uneconomical, specific groups of bacteria generally associated with fecal matter are used as indicators of fecal contamination.

Total Coliforms:

This group of bacteria comprises species that are commonly associated with fecal matter (human and animal) and nromal inhabitants of soil and vegetation.

Fecal Coliforms:

These bacteria are mainly species associated with human and animal fecal matter and indicate a relatively recent pollution input.

Fecal Streptococci:

This group of bacteria is largely associated with fecal pollution from animal and to a lesser extent man. The geometric mean of the FS results is mainly used in a ratio with the corresponding FC geometric mean (FC/FS) to gain information on the source (human or nonhuman) of pollution within areas adjacent to or at an input. If this ratio is greater than 4.0, the source of bacterial

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contamination is likely of human origin. If the ratio is less than 0.7, then the source is most likely nonhuman (Geldreich and Kenner, 1969)[1] . It should be noted that this ratio is used to determine the source and not the safety of the water, as animals are a potential source of organisms pathogenic to humans.

RESULTS

During May (Figure 3), TC, FC and FS levels were low throughout the river with highest densities being found along the American and Canadian shorelines. The TC levels (223/100 ml) were higher near the American shore when compared to the densities along the Canadian shore (159/100 ml). FC levels were highest just south of Sarnia (34/100 ml) while the highest FS levels of 18/100 ml occurred in the Marysville, Michigan area.

Results of the June survey (Figure 4) indicated significant increases in TC levels at the head of the river, around Marysville and along the Canadian shoreline down to Port Lampton. The TC Recreational Use Criteria was exceeded near Marysville (Station 15-50' and 12-100') at a level of 1210/100 ml and at Port Lampton (Station 5-900') where the density of TC was 1020/100 ml. FC and FS levels in June were found to be low and, in general, not significantly different from the May levels.

In August (Figure 5), the TC results revealed generally worsening conditions along the Canadian shore, below Sarnia, and at the head of the river. Along the American shore, conditions seemed to stabilize with TC concentrations not significantly different from those found in June. TC densities exceeded the Recreational Use Criteria in the Marysville area at 1220/100 ml and along the Canadian shore at 1310/100 ml.

[1] Geldreich, E.E. and Kenner, B.A. 1969. Concepts of Fecal Streptococci in Stream Pollution. Journal WPCF, 41(8), R336-R352.

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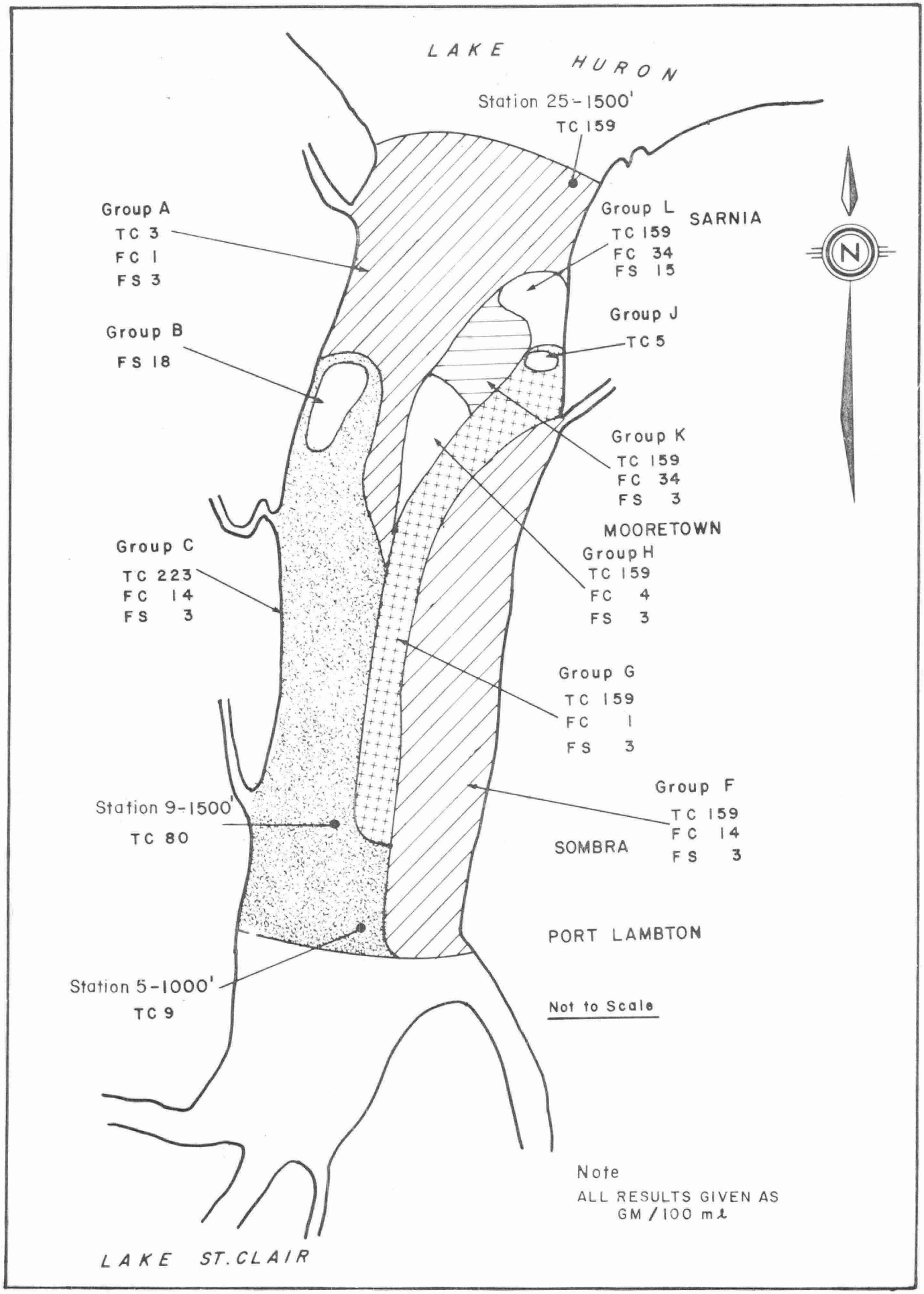

FIGURE 3 : ST. CLAIR RIVER SURVEY — MAY, 1973

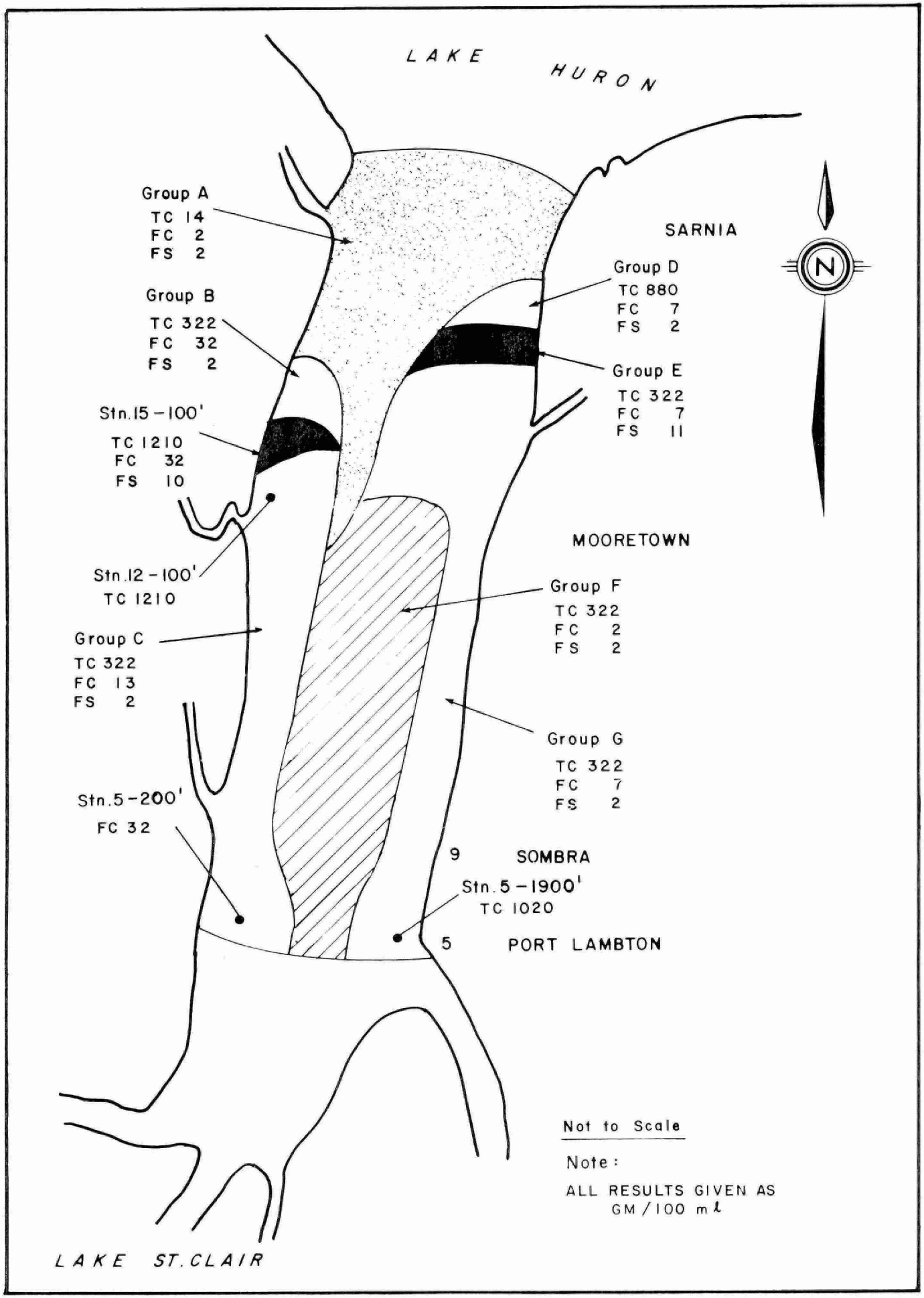

FIGURE 4 : ST. CLAIR RIVER SURVEY – JUNE, 1973

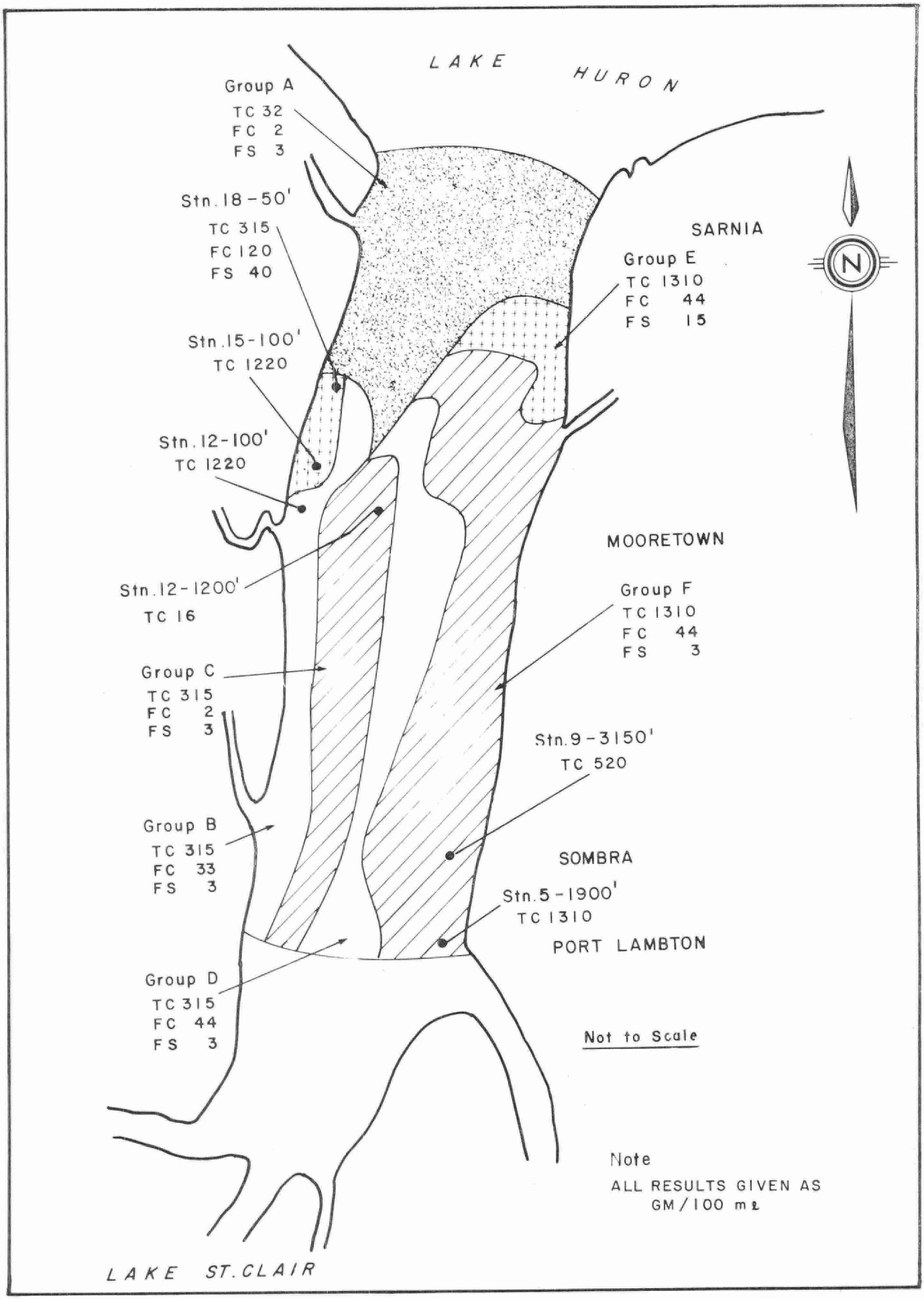

FIGURE 5 : ST. CLAIR RIVER SURVEY – AUGUST, 1973

TABLE 1

Ministry of the Environment Bactrial Criteria

Maximum permissible bacterial levels in water that is to be used for:

Recreational Use

Total Coliforms	1000/100 ml
Fecal Coliforms	100/100 ml
Fecal Streptococci	20/100 ml

Private Water Supplies

	To Be Treated By Chlorination Only	To Be Treated By Chlorination And Filtration
	100/100 ml	400/100 ml
	10/100 ml	40/100 ml
	1/100 ml	4/100 ml
Heterotrophic Bacteria	1000/100 ml	4000/100 ml

Public Surface Water Supplies

	Receiving Full Treatment
Total Coliforms	5000/100 ml
Fecal Coliforms	500/100 ml
Fecal Streptococci	50/100 ml
Heterotrophic Bacteria	100000/100 ml

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Low FC levels were found throughout most of the river during August with the exception of the area around Marysville, which exceeded the FC criteria at 120/100 ml. The FC/FS ratio in this area was 3 indicating combined human and nonhuman fecal pollution with perhaps the majority being from improperly treated human waste. Both the American and Canadian shoreline areas revealed significant increases in FC concentrations over the June levels.

Most of the river had low FS levels (3/100 ml) during August with the exceptions of the area south of Sarnia to approximately Talford Creek (15/100 ml) and the Marysville area which had FS densities of 40/100 ml, a significant increase from June.

During October (Figure 6), conditions along the American shore from Marysville to St. Clair, Michigan, showed some improvement. TC, FC and FS levels all showed significant decreases in this area, declining to 174, 28 and 17/100 ml respectively.

Along the Canadian shore, no improvement was observed. TC levels remained above the Recreational Use Criteria (1440/100 ml) and were not significantly different from the August levels. In general, FC concentrations along the Canadian shore were not significantly different from the August levels and remained below the criteria. One area near Moore, Ontario (Station 12-2450') had FC levels of 275/100 ml. The FC/FS ratio was greater than 4 indicating pollution from improperly treated human waste.

No significant differences in FS densities along the Canadian shore were shown to exist between August and October. October FS levels were generally low (2/100 ml) with higher levels occurring just south of Sarnia (16/100 ml) and in the Sombra and Port Lampton areas (14/100 ml).

To further assess bacteriological density patterns in the St. Clair River, a number of graphs were prepared (Figures 7-18) to show fluctuations of each parameter near both shores for each study. The X-axis represents the relative

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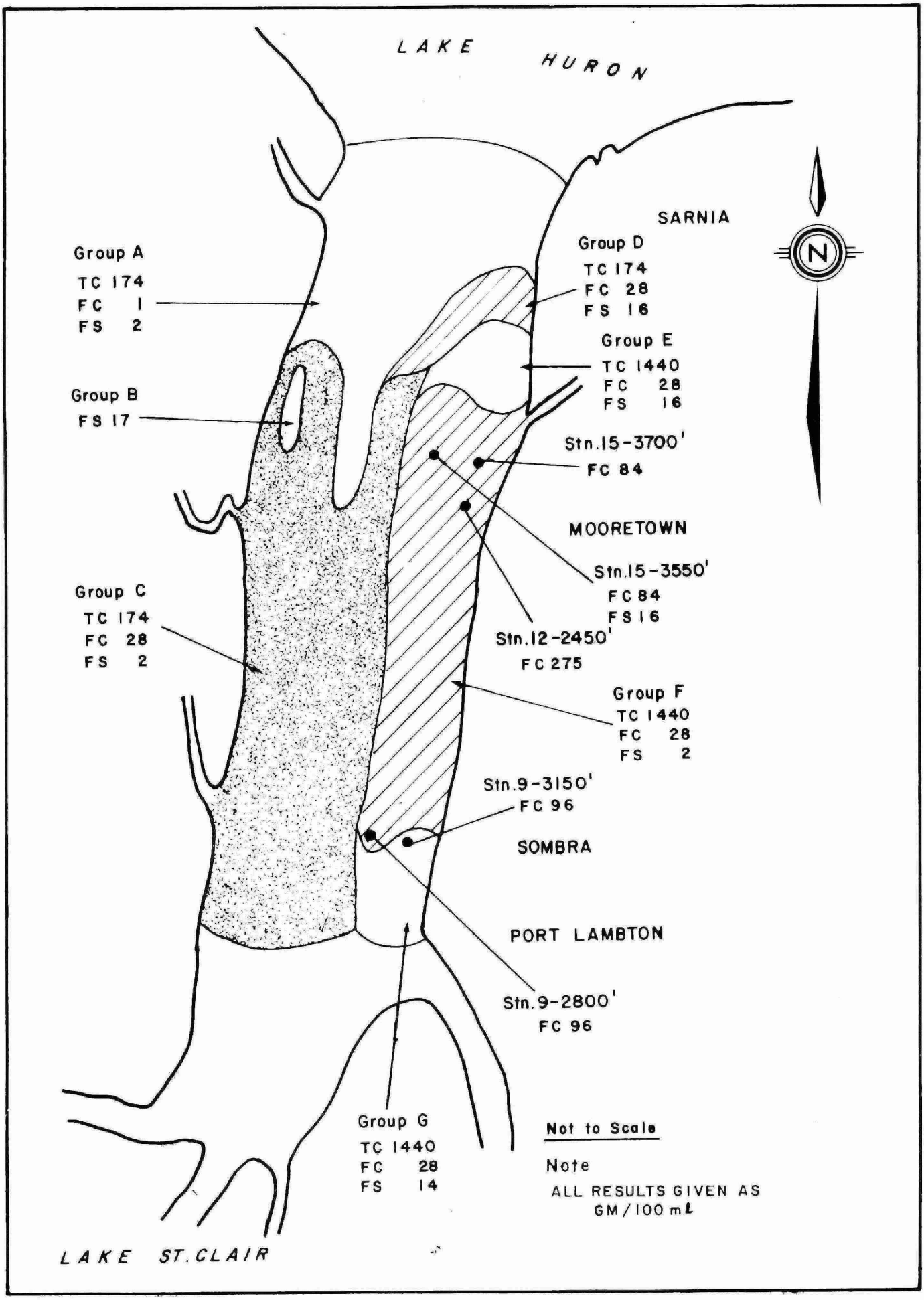

FIGURE 6 : ST. CLAIR RIVER SURVEY - OCTOBER, 1973

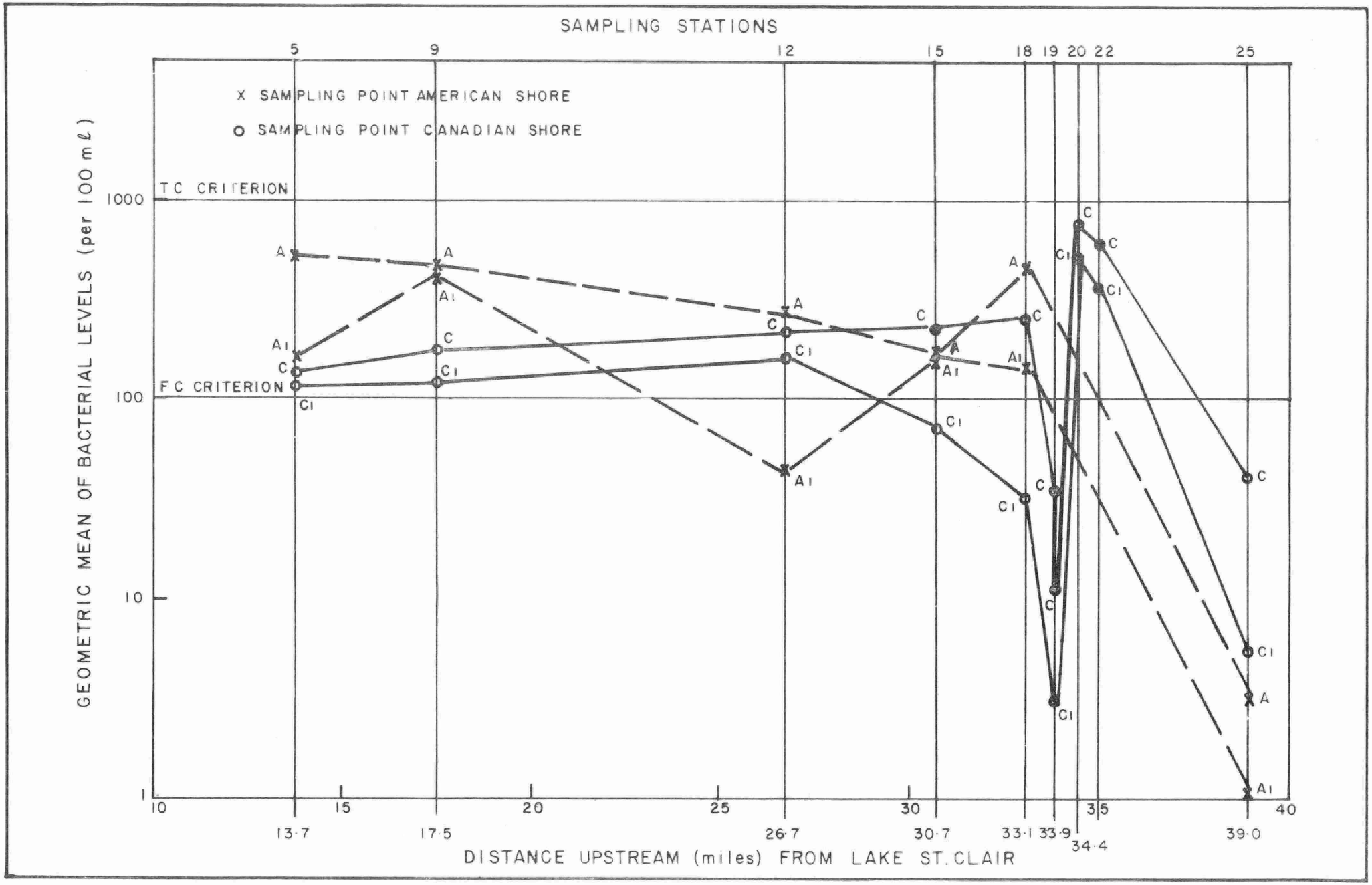

FIGURE 7: ST. CLAIR RIVER 1973 – LEVELS OF TOTAL COLIFORMS DURING MAY AT STATIONS CLOSEST TO (A & C) AND NEXT CLOSEST TO (A1 & C1) THE AMERICAN AND CANADIAN SHORELINES

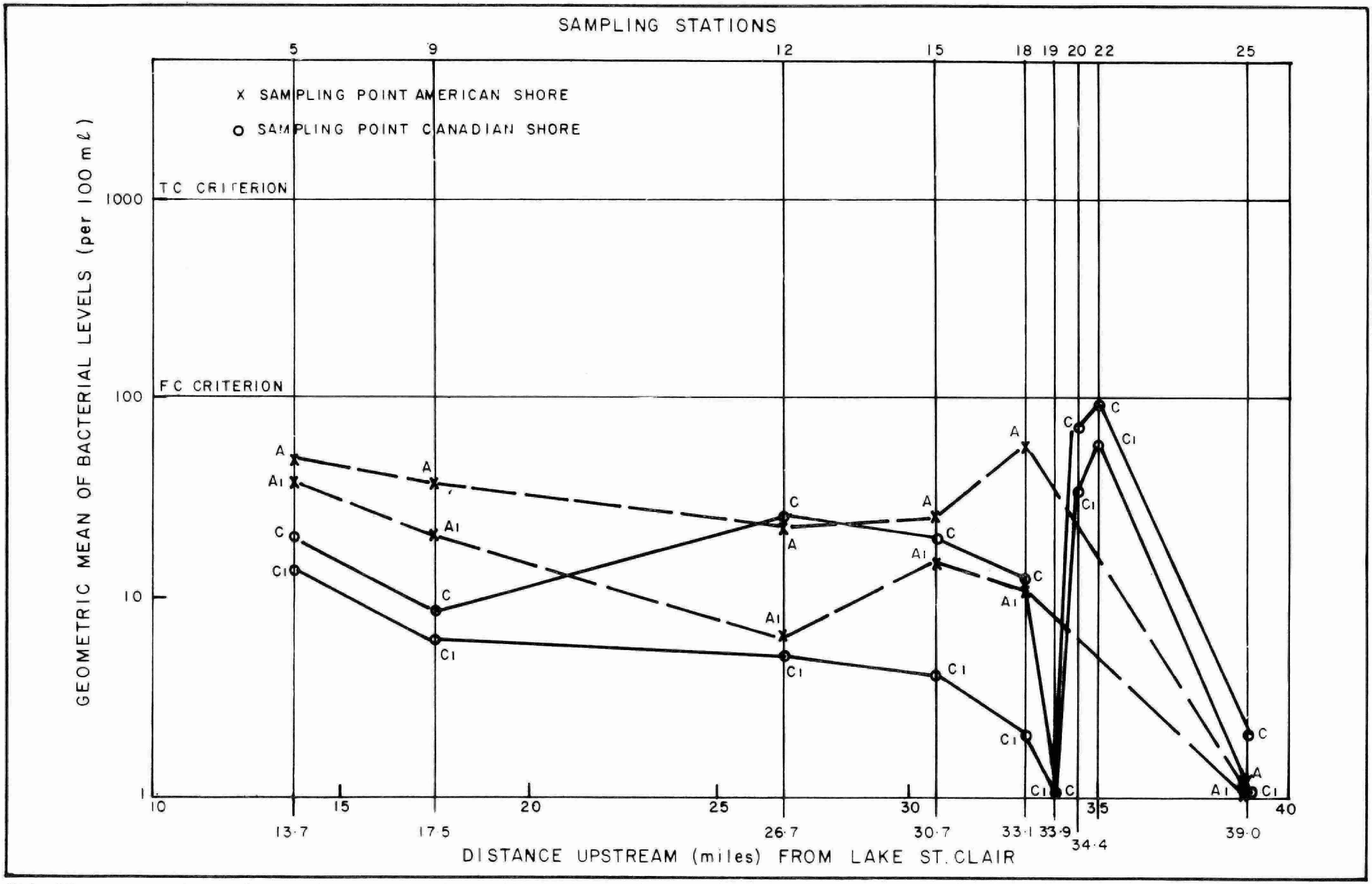

FIGURE 8: ST. CLAIR RIVER 1973 – LEVELS OF FECAL COLIFORMS DURING MAY AT STATIONS CLOSEST TO (A & C) AND NEXT CLOSEST TO (A1 & C1) THE AMERICAN AND CANADIAN SHORELINES

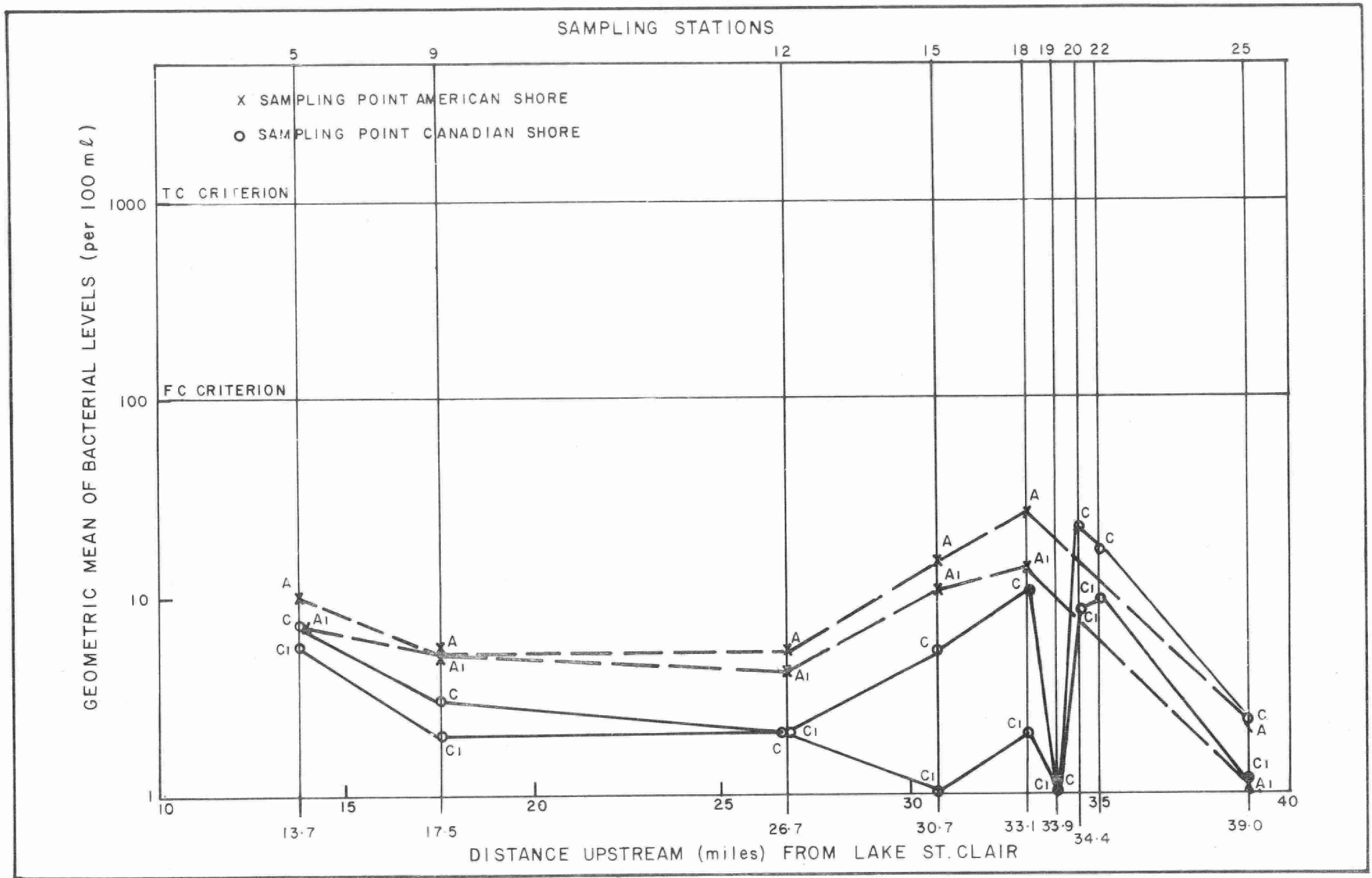

FIGURE 9 : LAKE ST. CLAIR 1973 — LEVELS OF FECAL STREPTOCOCCI DURING MAY AT STATIONS CLOSEST TO (A & C) AND NEXT CLOSEST TO (A1 & C1) THE AMERICAN AND CANADIAN SHORELINES

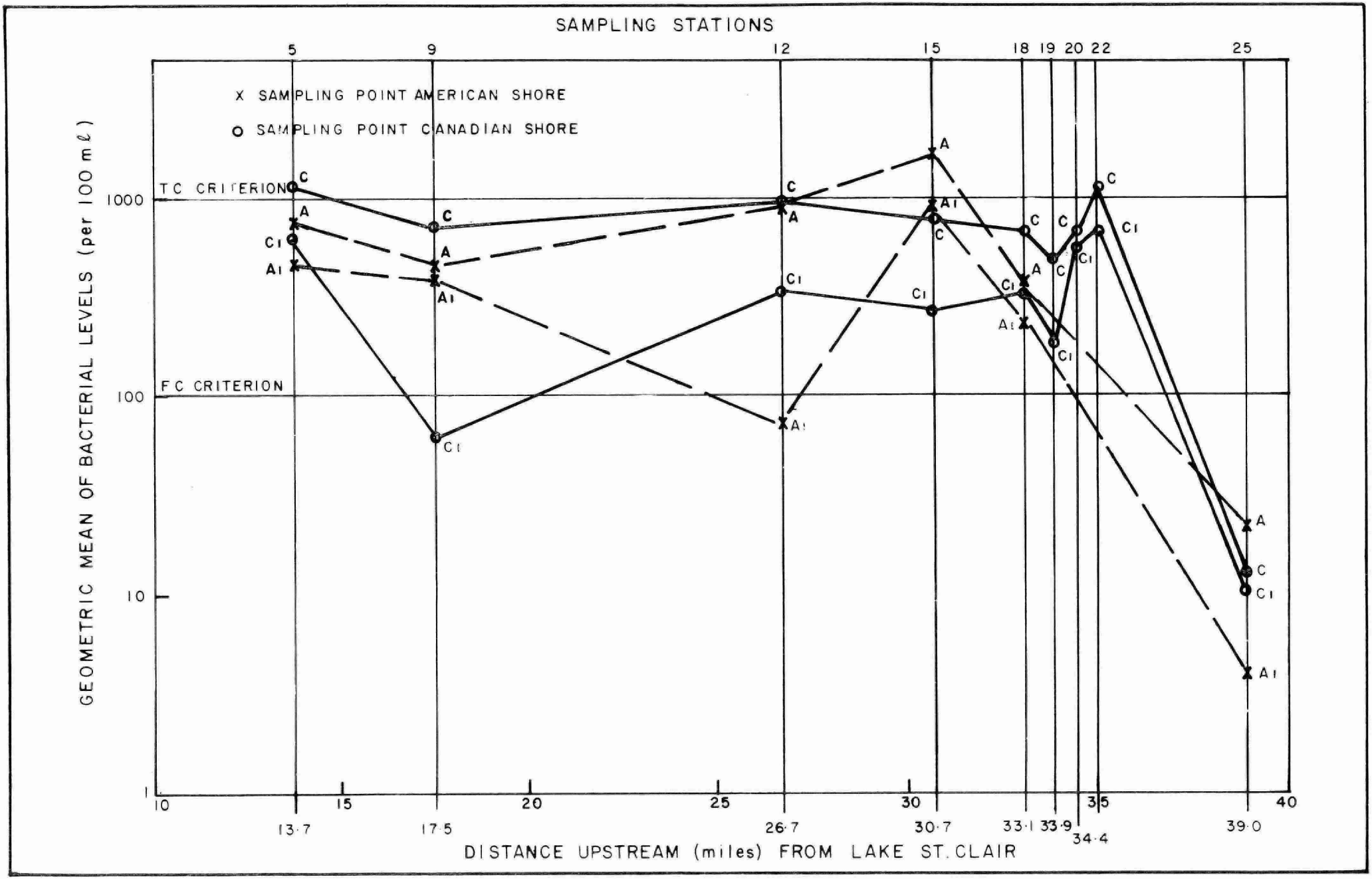

FIGURE 10: ST. CLAIR RIVER 1973 – LEVELS OF TOTAL COLIFORMS DURING JUNE AT STATIONS CLOSEST TO (A & C) AND NEXT CLOSEST TO (A1 & C1) THE AMERICAN AND CANADIAN SHORELINES

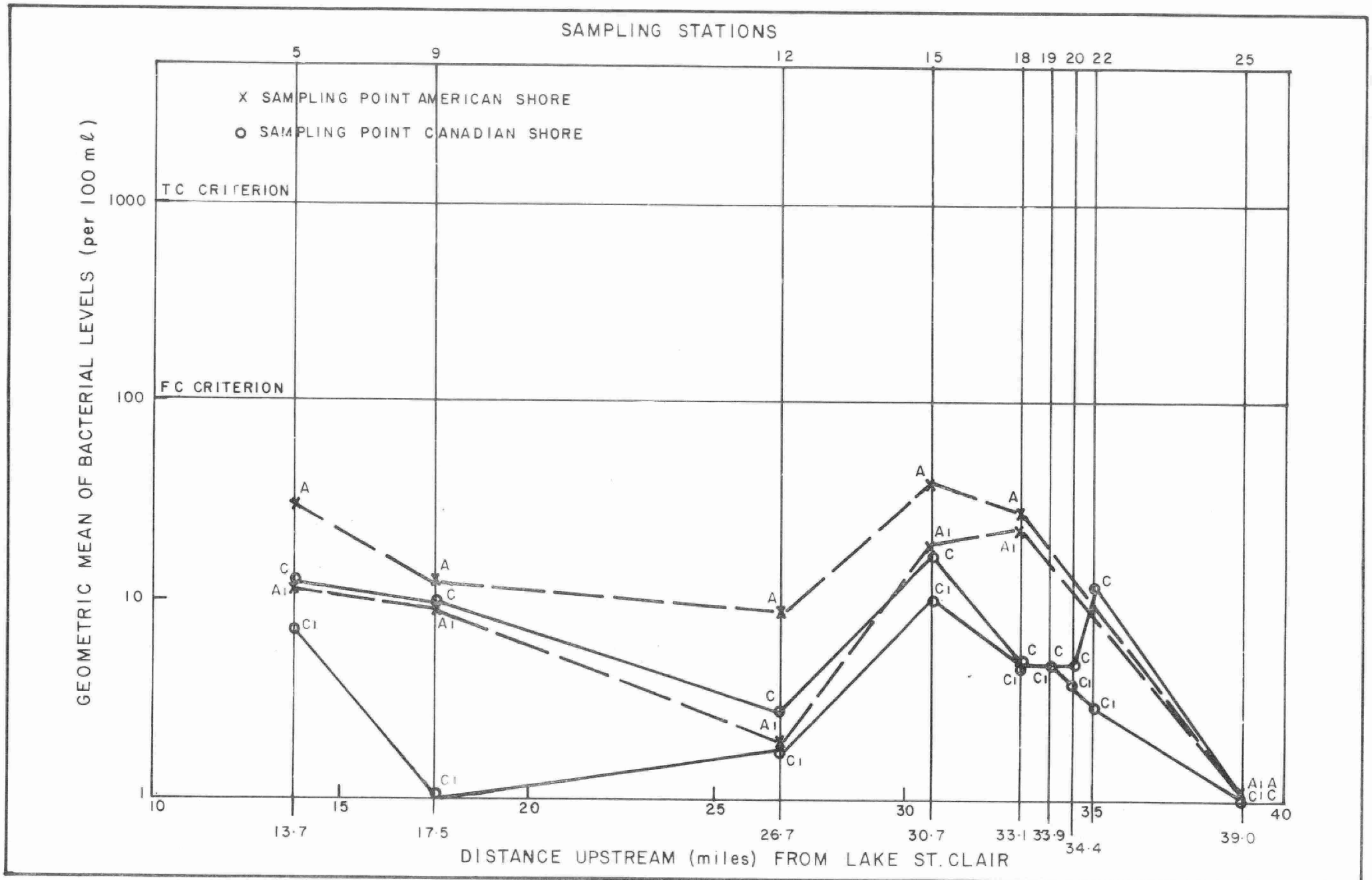

FIGURE 11: ST. CLAIR RIVER 1973 — LEVELS OF FECAL COLIFORMS DURING JUNE AT STATIONS CLOSEST TO (A & C) AND NEXT CLOSEST TO (A1 & C1) AMERICAN AND CANADIAN SHORELINES

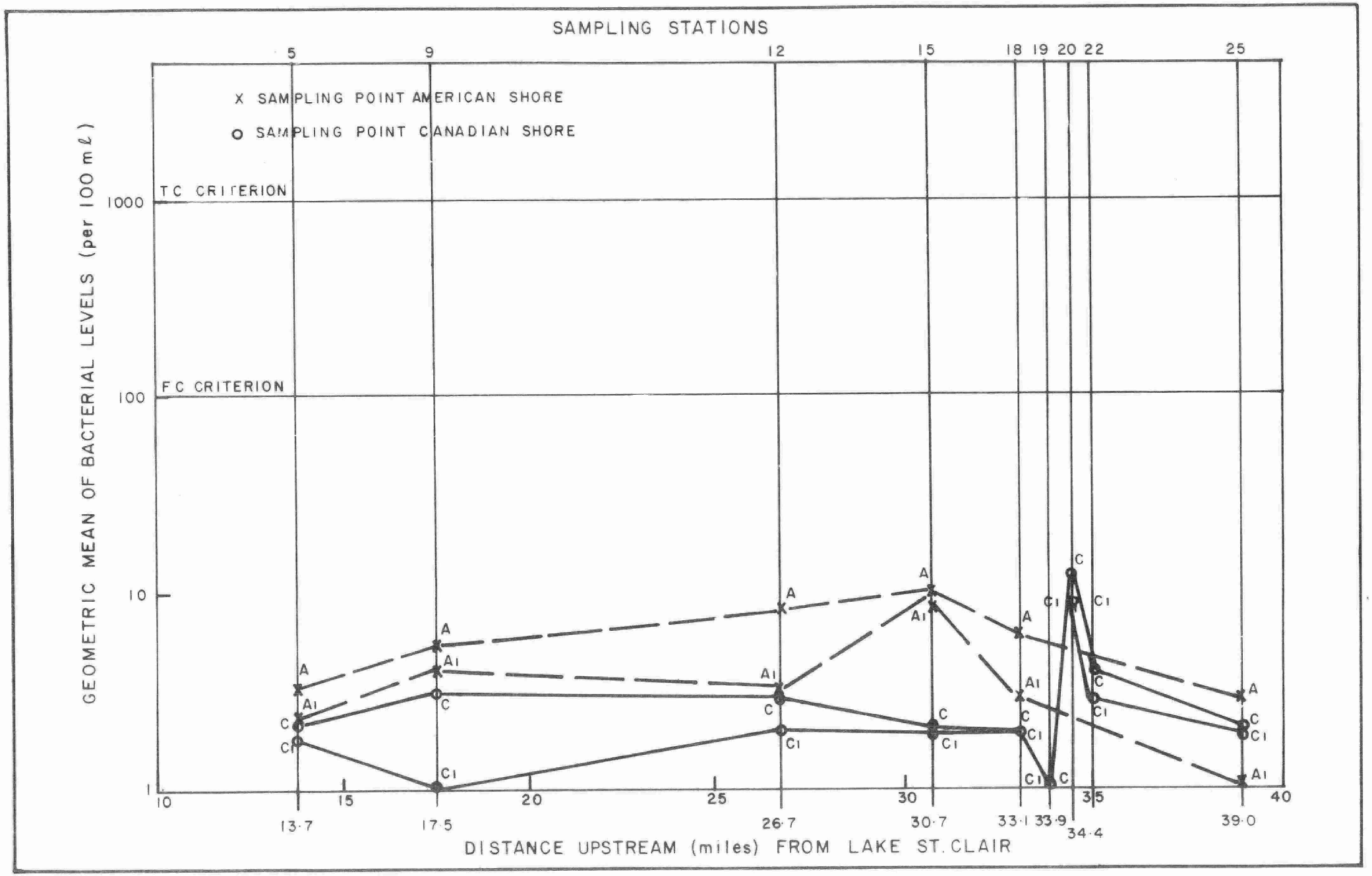

FIGURE 12 : ST. CLAIR RIVER 1973 – LEVELS OF FECAL STREPTOCOCCI DURING JUNE AT STATIONS CLOSEST TO (A & C) AND NEXT CLOSEST TO (A1 & C1) THE AMERICAN AND CANADIAN SHORELINES

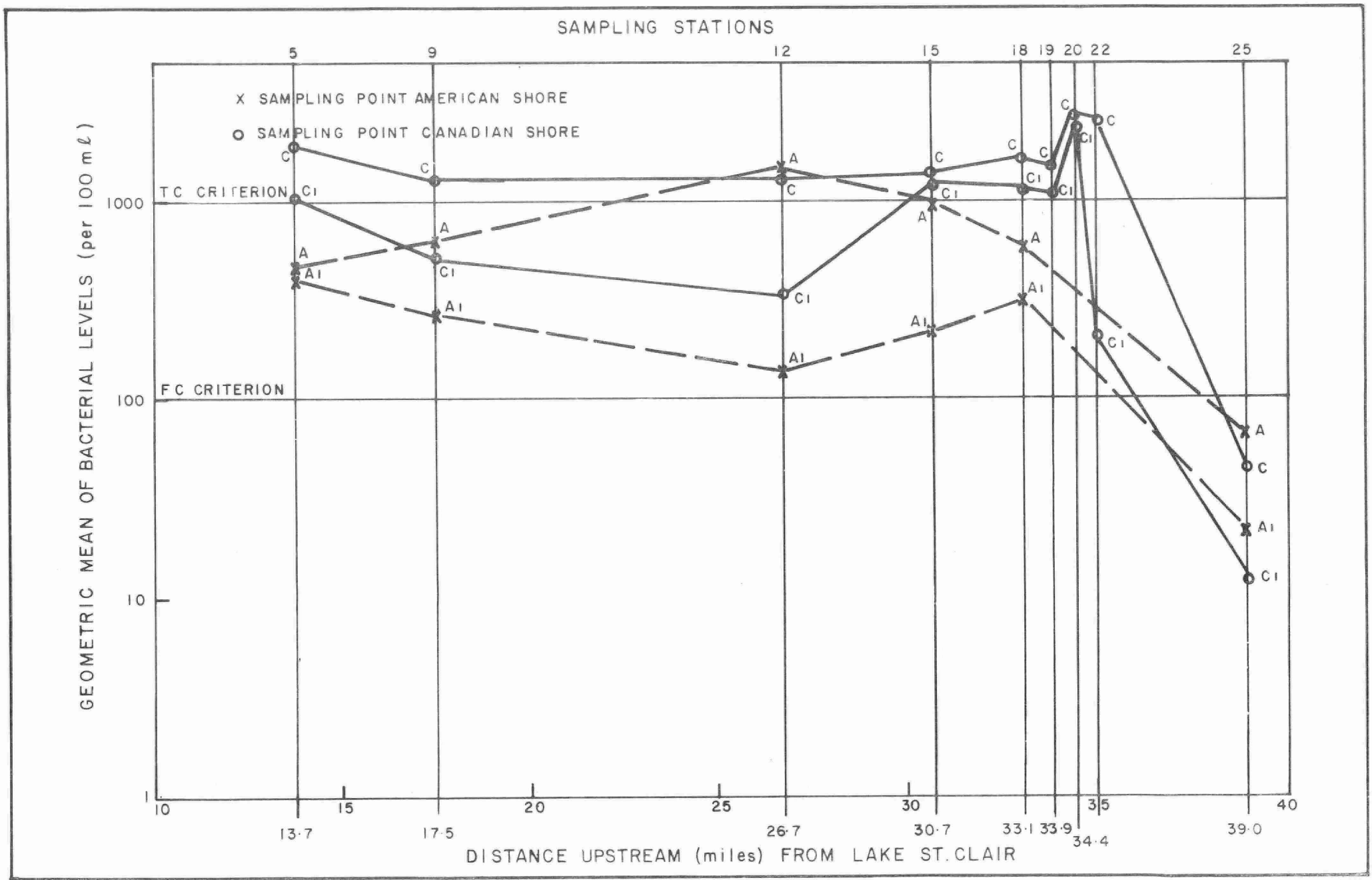

FIGURE 13 : ST. CLAIR RIVER 1973 – LEVELS OF TOTAL COLIFORMS DURING AUGUST AT STATIONS CLOSEST TO (A & C) AND NEXT CLOSEST TO (A1 & C1) THE AMERICAN AND CANADIAN SHORELINES

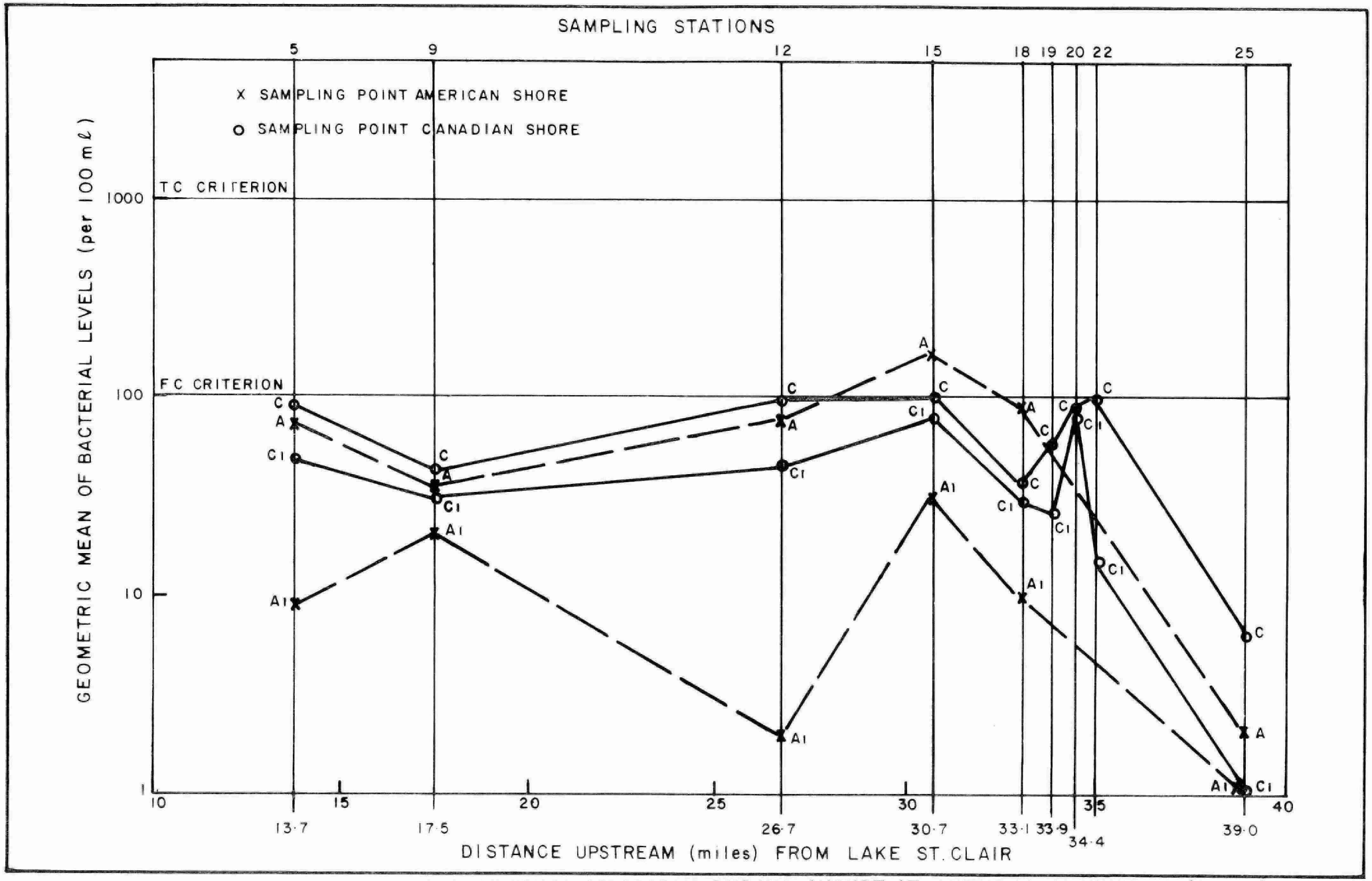

FIGURE 14: ST. CLAIR RIVER 1973 — LEVELS OF FECAL COLIFORMS DURING AUGUST AT STATIONS CLOSEST TO (A & C) AND NEXT CLOSEST TO (A1 & C1) THE AMERICAN AND CANADIAN SHORELINES

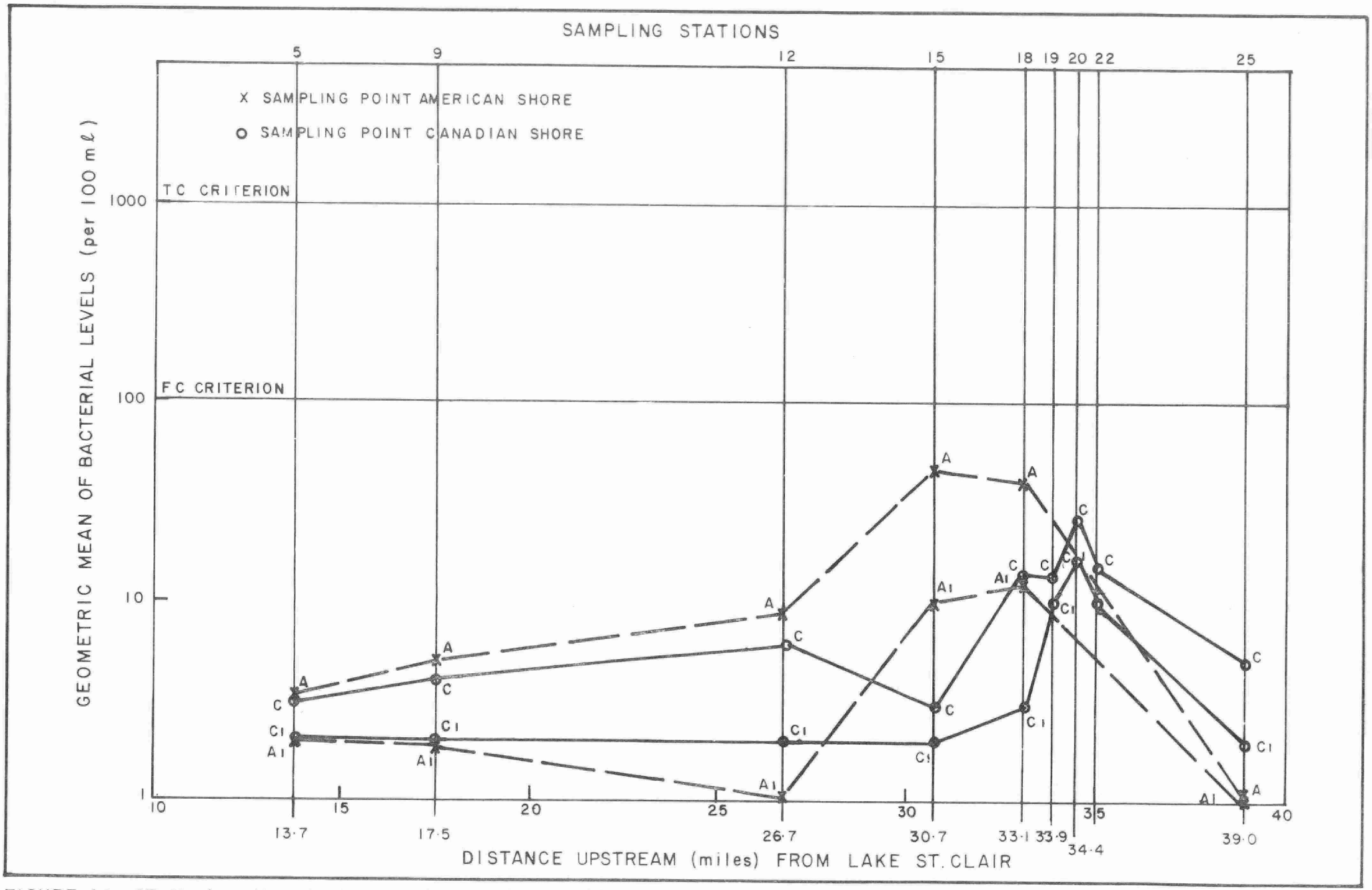

FIGURE 15 : ST. CLAIR RIVER 1973 – LEVELS OF FECAL STREPTOCOCCI DURING AUGUST AT STATIONS CLOSEST TO (A & C) AND NEXT CLOSEST TO (A1 & C1) THE AMERICAN AND CANADIAN SHORELINES

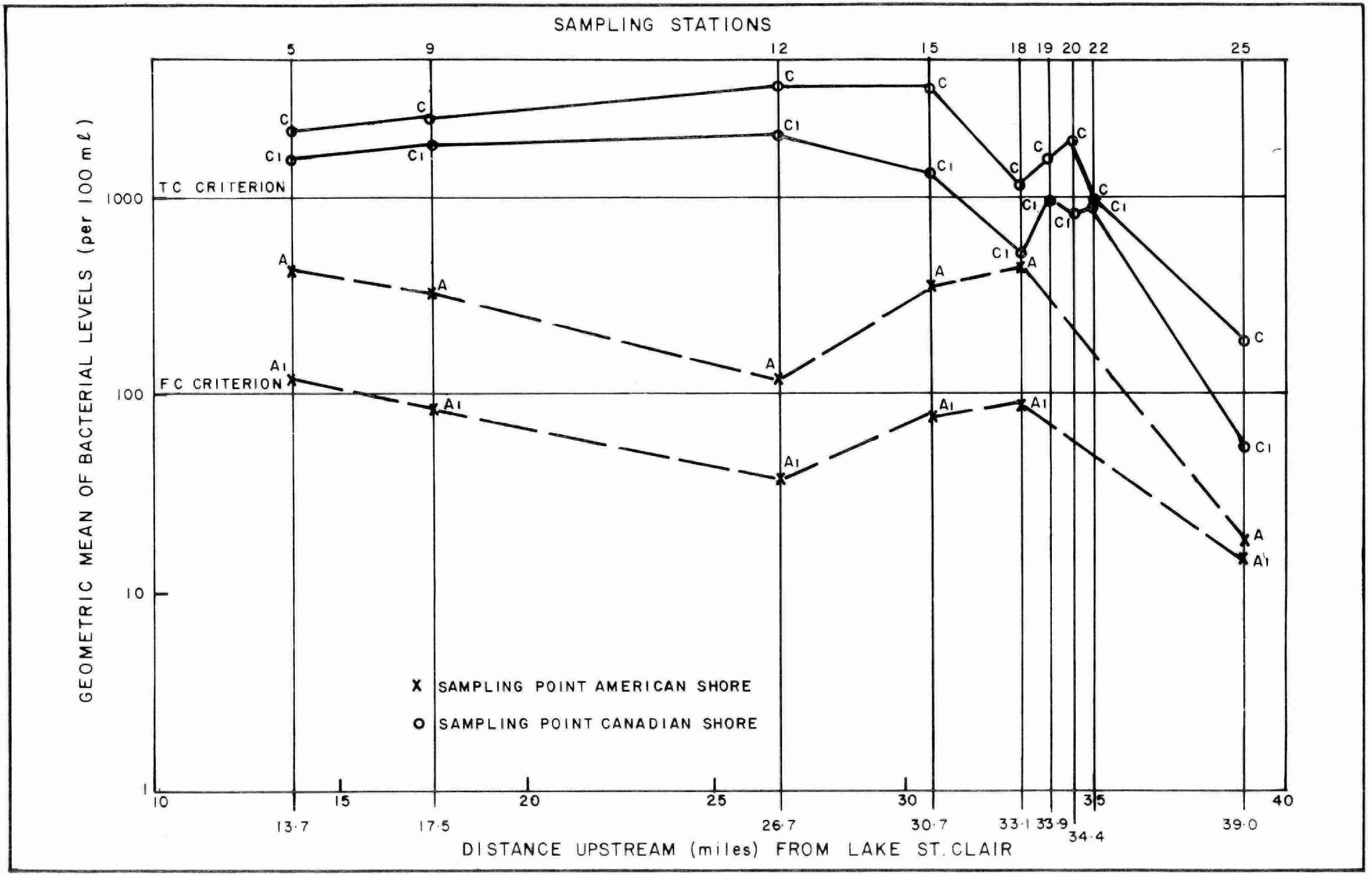

FIGURE 16 : ST. CLAIR RIVER 1973 — LEVELS OF TOTAL COLIFORMS DURING OCTOBER AT STATIONS CLOSEST TO (A & C) AND NEXT CLOSEST TO (A1 & C1) THE AMERICAN AND CANADIAN SHORELINES

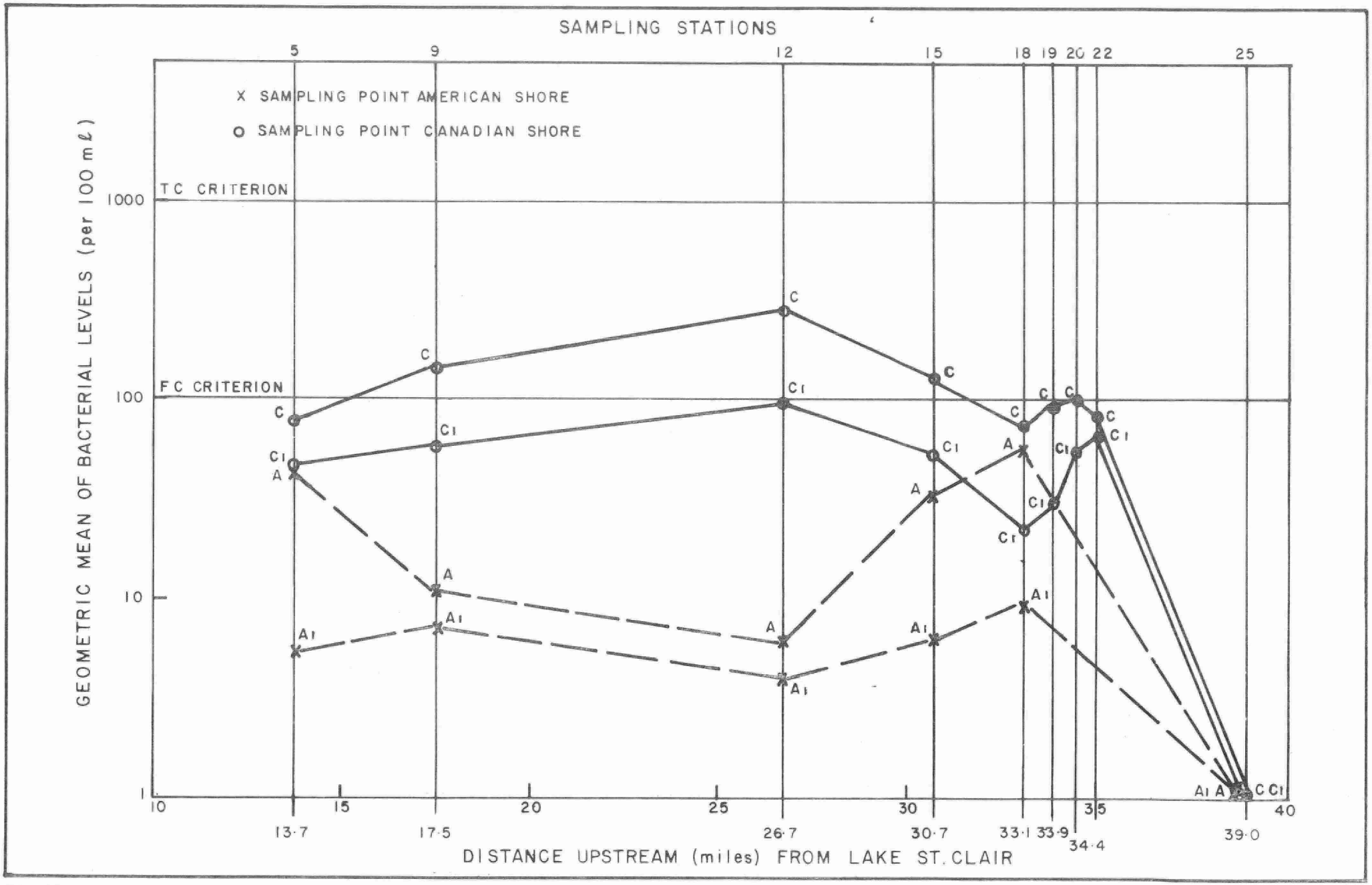

FIGURE 17 : ST. CLAIR RIVER 1973 — LEVELS OF FECAL COLIFORMS DURING OCTOBER AT STATIONS CLOSEST TO (A & C) AND NEXT CLOSEST TO (A1 & C1) THE AMERICAN AND CANADIAN SHORELINES

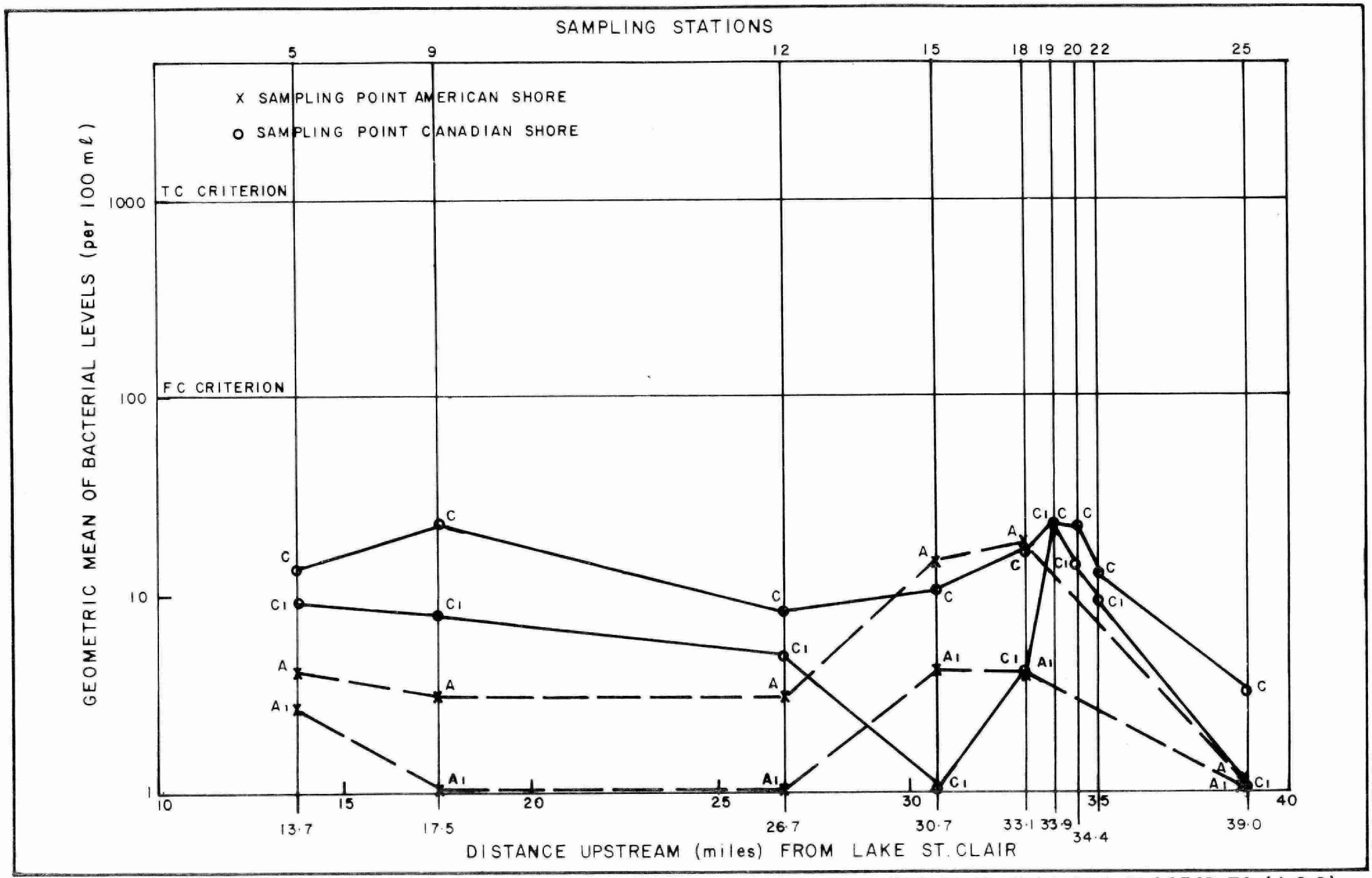

FIGURE 18 : ST. CLAIR RIVER 1973 — LEVELS OF FECAL STREPTOCOCCI DURING OCTOBER AT STATIONS CLOSEST TO (A & C) AND NEXT CLOSEST TO (A1 & C1) THE AMERICAN AND CANADIAN SHORELINES

distance, in miles, of sampling ranges along the river upstream from Lake St. Clair and the Y-axis represents bacterial densities.

For each shoreline (American and Canadian), the bacterial concentrations for each range of the two sampling points closest to shore were plotted for each parameter.

The plots demonstrated (in conjunction with Figures 3-6) that, along the Canadian shore, all parameters increased from low levels north of Sarnia to peak levels either just south of Imperial Oil (Range 22) or just south of Dow Chemical (Range 20) then sharply decreased between Dow Chemical and Sun Oil Co. (Range 19). A second peak occurred just north of Talford Creek (Range 18). Downstream levels either remained stable or decreased slightly. This effect was shown in all studies but to lesser degrees as the season progressed.

Along the American shoreline, bacterial levels in May and October increased from low levels north of Port Huron to peak levels just north of Marysville (Range 18), then either stabilized or decreased down river. In June and August, however, the peak levels occurred just south of Marysville (Range 15).

DISCUSSION

Results of the four surveys of the St. Clair River revealed a seasonal variation in bacteriological levels with a general deterioration in conditions from May to August.

There are a number of factors which, when compounded, may influence bacterial levels in the St. Clair River system. Inputs from sewage treatment plants could increase both bacterial and nutrient concentrations. Proper nutrient and temperature conditions might allow after-growth of total coliform and other heterotrophic bacteria adding to elevated bacterial levels. Increases in ship traffic and runoff from agricultural land may also contribute to the pressures on

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the river system. The fact that TC densities exceeded the Recreational Use Criteria while FC levels were generally below criteria levels suggest the inputs to the St. Clair system are not primarily of fecal origin. Certain areas, however, such as around Marysville, Michigan, and Moore, Ontario, show signs of greater fecal pollution as both TC and FC levels were found to exceed the criteria at times. Plots of bacterial levels along the shoreline reveal that peak levels occur near the northern end of the river suggesting greater influences from the Port Huron-Sarnia area.

In general, the TC, FC and FS concentrations are above those found at the head of the river near Lake Huron. This, in conjunction with FC/FS ratios at many stations of 4 or greater, suggest that the fecal contamination occurring, emanates from the more populated areas and is likely of human origin.

Bacterial levels show marked decreases during the various surveys in the area of the Canadian shoreline just south of Dow Chemical Co. (Range 19). It is possible that the effluents from various chemical industries are having an inhibitory effect on the bacteria as they pass downstream. Further research would be necessary, however, before any definite conclusion could be reached on this point.

As a result of the MOE TC criteria being exceeded in the area of Marysville to St. Clair, Michigan, and along the entire Canadian shore, ingestion of this water may be hazardous to human health. The river poses an even greater public health threat in the areas where both the TC and FC criteria were exceeded. Results are not available for the immediate Sarnia-Port Huron area, therefore, it is impossible to comment on the water quality. This area should be included in future water quality surveys. All parameters remained below the suggested permissible Public Surface Water Supplies criteria during the entire survey season.

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ABSTRACT

Surveys were conducted during May, June and August on the Detroit River. Determinations were made of the concentrations of Total Coliforms, Fecal Coliforms and Fecal Streptococci.

Results demonstrated that in May water quality on the entire Canadian shore was homogeneous and of poorer quality than the water entering from Lake St. Clair. Water quality had deteriorated by June through much of the River below Windsor with a ten fold increase in Total Coliforms and a five fold increase in Fecal Coliforms. Both parameter concentrations were well above acceptable levels and the FC/FS ratio was indicative of human fecal waste. During the final survey in August bacterial levels had decreased over much of the river below Windsor but Total and Fecal Coliform densities were still unacceptably high and the FC/FS ratio again indicated human fecal pollution.

INTRODUCTION

The Detroit River (Fig.1) is the interconnecting waterway between Lake St. Clair (north end) and Lake Erie (south end). The Canadian City of Windsor and the American City of Detroit are on either side of the river and as a result the river is lying in one of the most heavily populated and industrialized regions of the Great Lakes system. The Detroit River receives industrial and municipal wastes and at the same time is also a source of drinking water for the local populations. During 1973 three monitoring surveys of the Detroit River were carried out in May, June and August. Determinations were made of the levels of the three sanitary bacteriological parameters; Total coliforms (TC), Fecal coliforms (FC) and Fecal streptococci (FS).

METHODS

FIELD PROCEDURES:

The initial survey (May) took place from May 17 to May 25 when double or triple samplings occurred at a majority of the sixty two sampling points located along the length of the river (FIG.2). A maximum period of five days separated the repeated sampling of a particular location.

The June and August studies consisted of at least two samplings (maximum 3) of each of the sixty two points, with both surveys lasting a total of four days.

All bacteriological samples were surface samples collected one meter below the water surface using a sterile 237 ml rubber bulb connected to a modified piggy back sampling device.

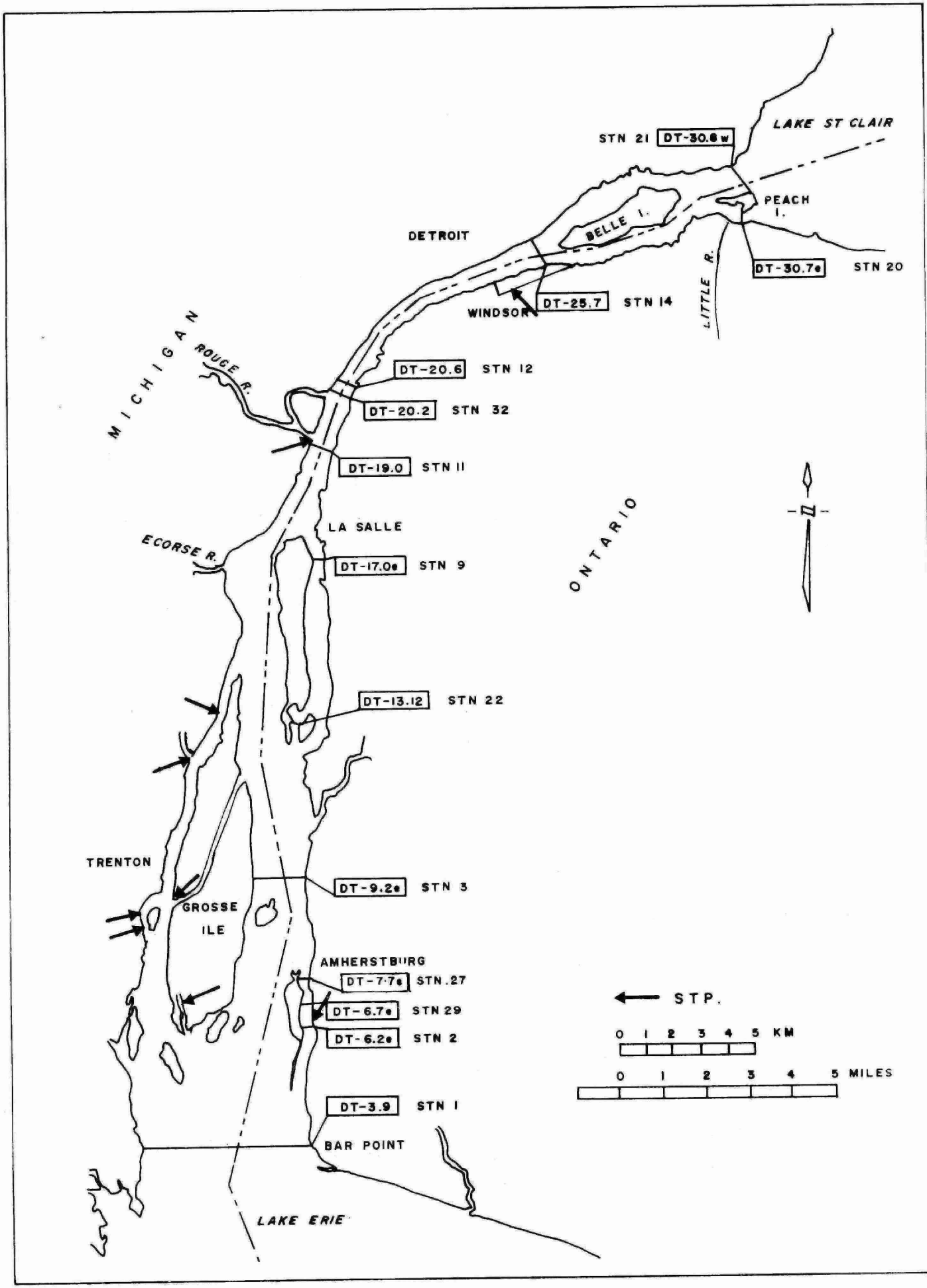


FIGURE 1 : DETROIT RIVER SURVEY AREA 1973 — STATION TRANSECT LOCATIONS

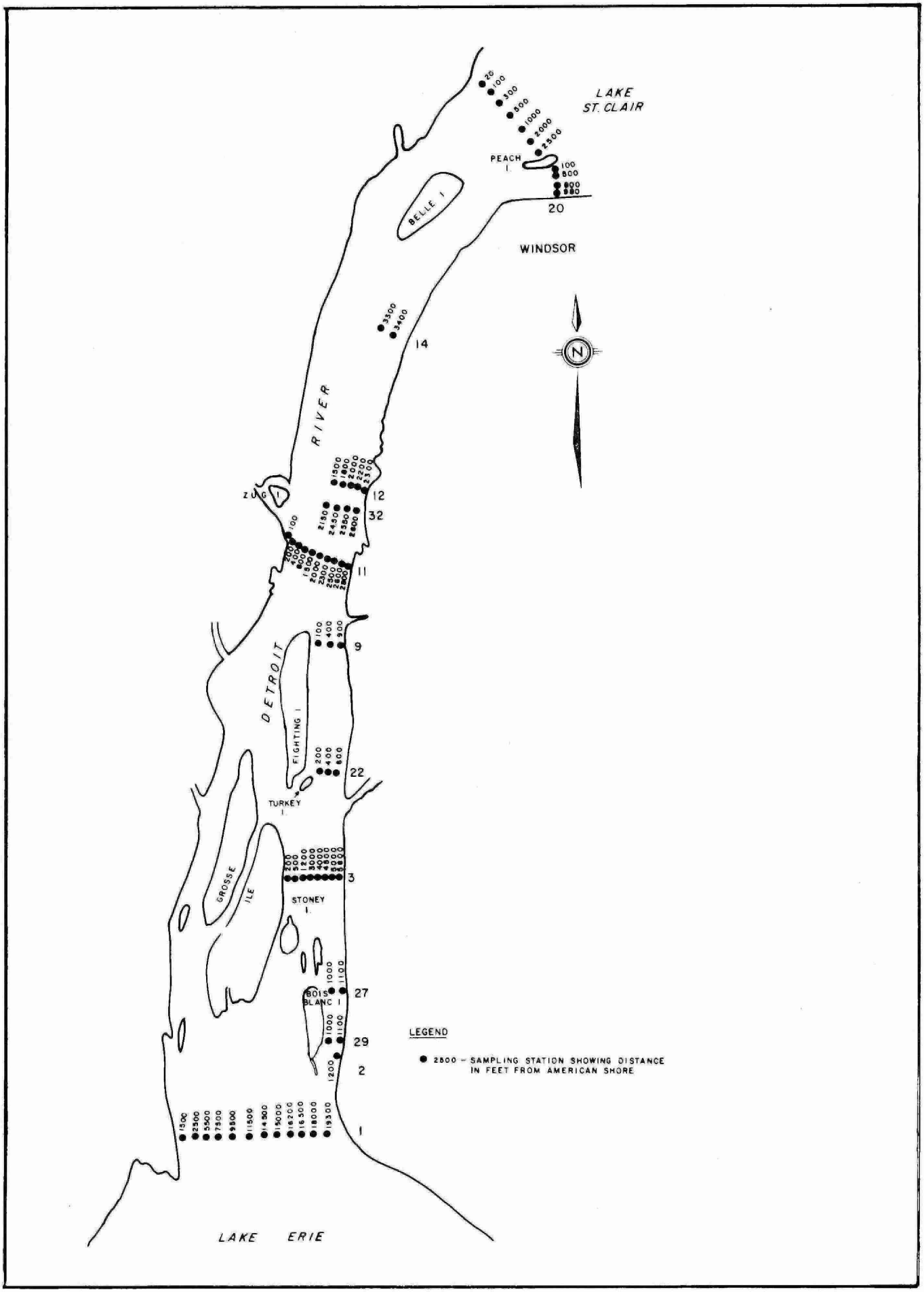


FIGURE 2 : DETROIT RIVER SURVEY AREA 1973 — STATION LOCATIONS

After collection the samples were transported on ice to the M.O.E. London laboratory for analysis within twenty four hours.

LABORATORY PROCEDURES:

All samples were analyzed for Total Coliform (TC), Fecal Coliform (FC) and Fecal Streptococci (FS). Membrane filtration analyses were conducted according to Standard Methods (13th edition) using m-Endo Agar Les (Difco) for TC, MacConkey Membrane Broth (Oxoid) for FC, and m-Enterococcus Agar (Difco) for FS. Analysis of samples were conducted within 24 hours of sampling.

STATISTICAL METHODS

Fluctuations in bacterial concentrations due to changing environmental conditions require that a great number of samples be taken to arrive at a mean value which is representative of a specific sample location or sampling area. The most appropriate mean for bacterial levels and this type of data is the geometric mean. The large amounts of bacteriological data generated from this survey necessitated statistical methods to summarize the results concisely and to facilitate an unbiased interpretation. For the surveys the daily results for each parameter were organized as replicate results for each station. The log geometric mean, the variance, and the standard error were then calculated for each parameter at each station.

Once the station group statistics had been obtained, an analysis of variance program (ANOVA) was used to group the stations into areas within the same statistical bacterial level. The ANOVA analysis was first performed on all survey stations. If the calculated F-ratio was less than the critical F-ratio (0.05 level), the stations were considered statistically the same and were summarized as a group with one set of overall group statistics.

At the same time as the ANOVA analyses were performed, the homogeneity of the variances was also checked using Bartlett's X^2 test of homogeneity. If either the F or X^2 was significant, indicating a non similar grouping, stations that were judged to be significantly different, based on a statistical circumspection of the data, were tested and, if necessary, eliminated until both the F-ratio and X^2 were nonsignificant. The withdrawn stations were regrouped with respect to geographic proximity. The calculations on all groups were repeated using the ANOVA program until each discrete group was homogeneous. The student-t test (using the log GM and S.E.) was used to compare overlapping homogeneous areas between each of the surveys.

CRITERIA

The Ontario Ministry of the Environment (MOE) Bacterial Criteria for various water uses are presented in Table 1. One of the prime reasons for inclusion of bacteriological parameters in water quality analysis is to indicate the presence of fecal contamination and thus the possible presence of pathogenic bacteria. Since the determination of specific pathogens in water is generally slow, laborious and uneconomical, specific groups of bacteria generally associated with fecal matter are used as indicators of fecal contamination.

TOTAL COLIFORMS

This group of bacteria comprises species that are commonly associated with fecal matter (human and animal) and normal inhabitants of soil and vegetation.

FECAL COLIFORMS

These bacteria are mainly species associated with human and animal fecal matter and indicate a relatively recent pollution input.

TABLE I

Ministry of the Environment Bacterial Criteria

Maximum permissible bacterial levels in water that is to be used for:

Recreational Use

Total Coliforms	1000/100 ml
Fecal Coliforms	100/100 ml
Fecal Streptococci	20/100 ml

Private Water Supplies

	To Be Treated By Chlorination Only	To Be Treated By Chlorination And Filtration
Total Coliforms	100/100 ml	400/100 ml
Fecal Coliforms	10/100 ml	40/100 ml
Fecal Streptococci	1/100 ml	4/100 ml
Heterotrophic Bacteria	1000/100 ml	4000/100 ml

Public Surface Water Supplies

	Receiving Full Treatment
Total Coliforms	5000/100 ml
Fecal Coliforms	500/100 ml
Fecal Streptococci	50/100 ml
Heterotrophic Bacteria	100000/100 ml

FECAL STREPTOCOCCI

This group of bacteria is largely associated with fecal pollution from animals and to a lesser extent man. The geometric mean of the FS results is mainly used in a ratio with the corresponding FC geometric mean (FC/FS) to gain information on the source (human or nonhuman) of pollution within areas adjacent to or at an input. If this ratio is greater than 4.0, the source of bacterial contamination is likely of human origin. If the ratio is less than 0.7 then the source is most likely nonhuman (Geldreich and Kenner, 1969)[1]. It should be noted that this ratio is used to determine the source and not the safety of the water, as animals are a potential source of organisms pathogenic to humans.

RESULTS & DISCUSSION

During May, (FIG.3) TC, FC and FS levels at the head of the river were in general low (58TC, 1FC and 6 FS/100 ml). An area closest to the Canadian shore (range 20) had higher bacterial densities and was included in a group which stretched from the head of the river south to Lake Erie. TC levels in this group exceeded the Recreational Use Criteria at 1750/100 ml. FC levels were below criteria at 58/100 ml, but this was higher than levels at Lake St. Clair. FS levels remained at 6/100 ml.

Just south of the Rouge River (range 11) very high single TC, FC and FS recoveries were observed of 110,000, 2800 and 2300/100 ml respectively.

During the June study (FIG.4) conditions at the head of the Detroit River (Ranges 20, 21) had deteriorated slightly. TC levels were 112/100 ml over most of the area at the head of the river. FC densities of 2/100 ml were not significantly different from May levels while FS densities of 26/100 ml were a significant increase over levels found in May.

[1]Geldreich, E.E., and Kenner, B.A., 1969. Concepts of Fecal Streptococci in Stream Pollution. Journal WPCF, 41(8), R336-352.

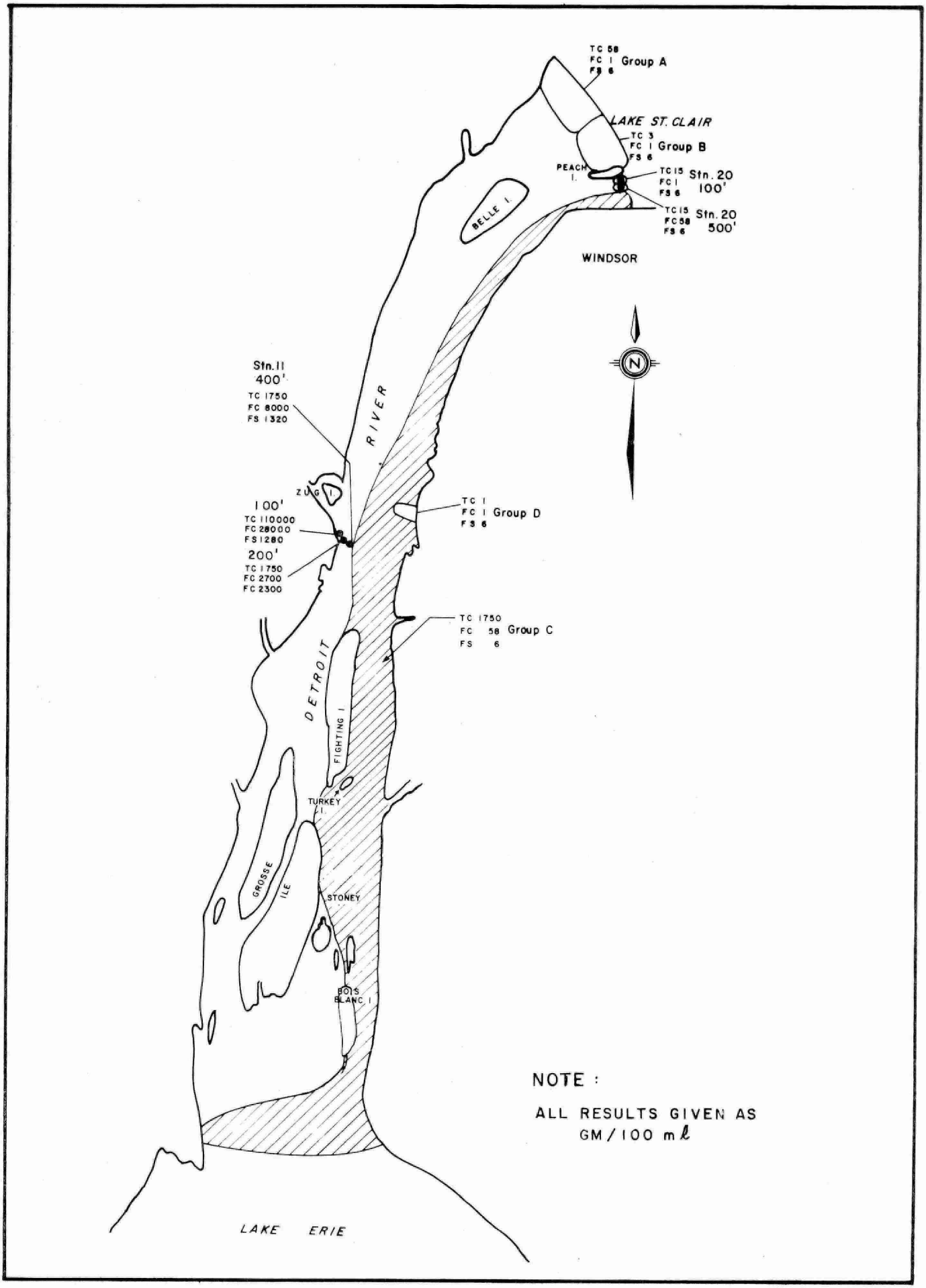


FIGURE 3 : DETROIT RIVER SURVEY — MAY, 1973

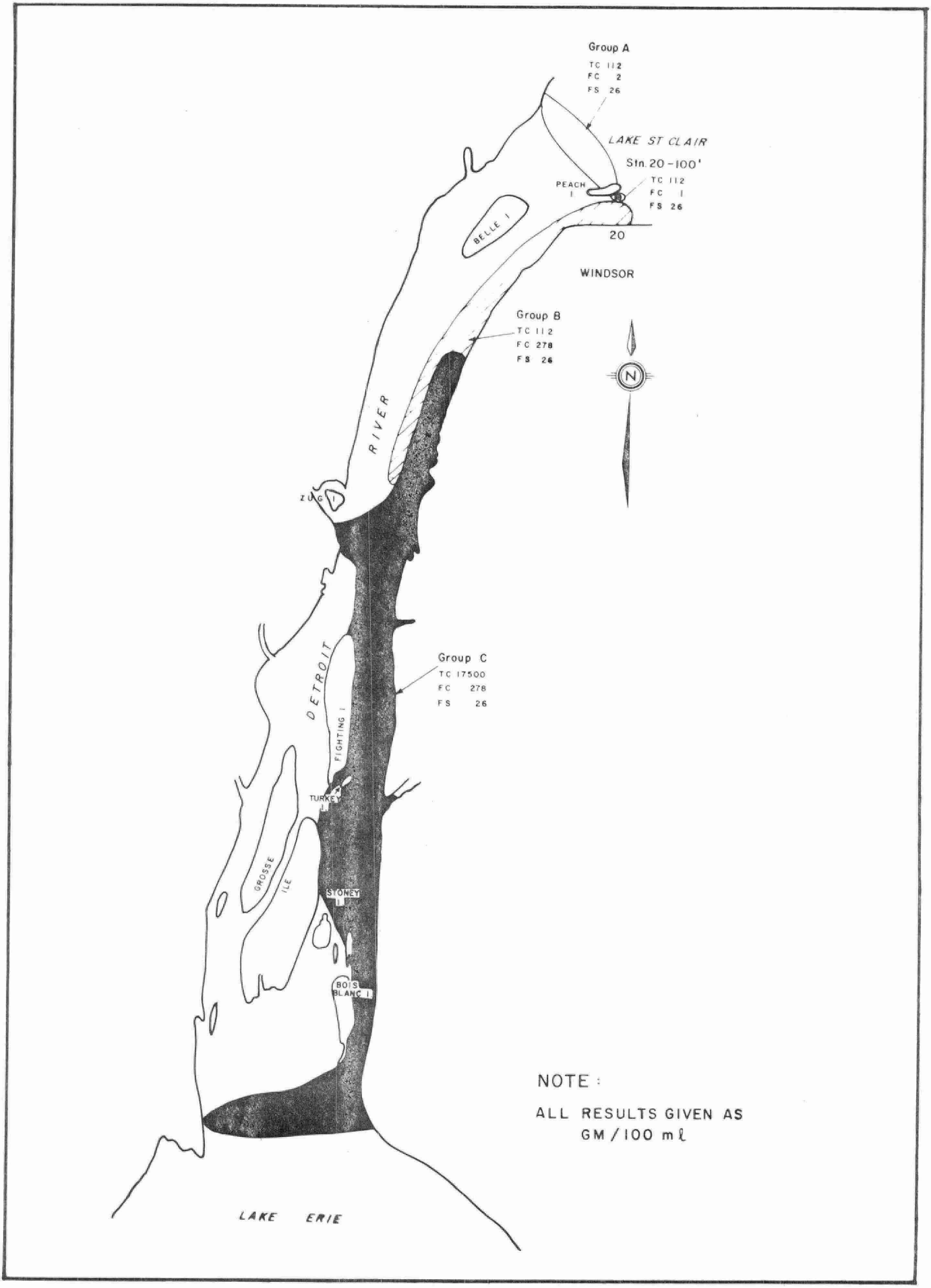


FIGURE 4 : DETROIT RIVER SURVEY – JUNE, 1973

Close to the Canadian shore from Lake St. Clair to the Windsor area TC levels were significantly decreased (112/100 ml) while FC and FS levels significantly increased (278 FC and 26 FS/100 ml). The FC concentration demonstrates recent fecal contamination and the FC/FS ratio is indicative of improperly treated human waste. In the Windsor area and south, TC densities further indicated water quality deterioration as levels were ten times higher than in May (17,500/100 ml). This level not only exceed the Recreational Use Criteria but the Public Surface Water Supply Criteria as well.

During the August survey (FIG.5) TC levels exceeded the Recreational Use Criteria from the head of the river south to Grosse Isle (2170/100 ml). These TC concentrations at the head of the river were significantly increased over June levels. Further south, however, from Zugg Island to Grosse Isle, these TC levels were a significant decrease from the June TC concentrations.
FC and FS densities were low (4 and 3/100 ml respectively) at the head of the river, along the Canadian shore and into mid-river near Zugg Island. At the head of the river (range 21) the FS recoveries showed a significant decrease from June levels. The Windsor shoreline south to approximately Zugg Island had both FC and FS levels significantly decreased from those found in June. Along the Canadian shore from south of Zugg Island to Grosse Isle elevated FC levels of 130/100 ml (Above Recreational Use Criteria) were detected. FS levels in this area were low at 3/100 ml, thus the FC/FS ratio was indicative of improperly treated human waste. While the FC levels in this area remained above criteria, both the FC and FS densities were significantly lower than they had been in June.

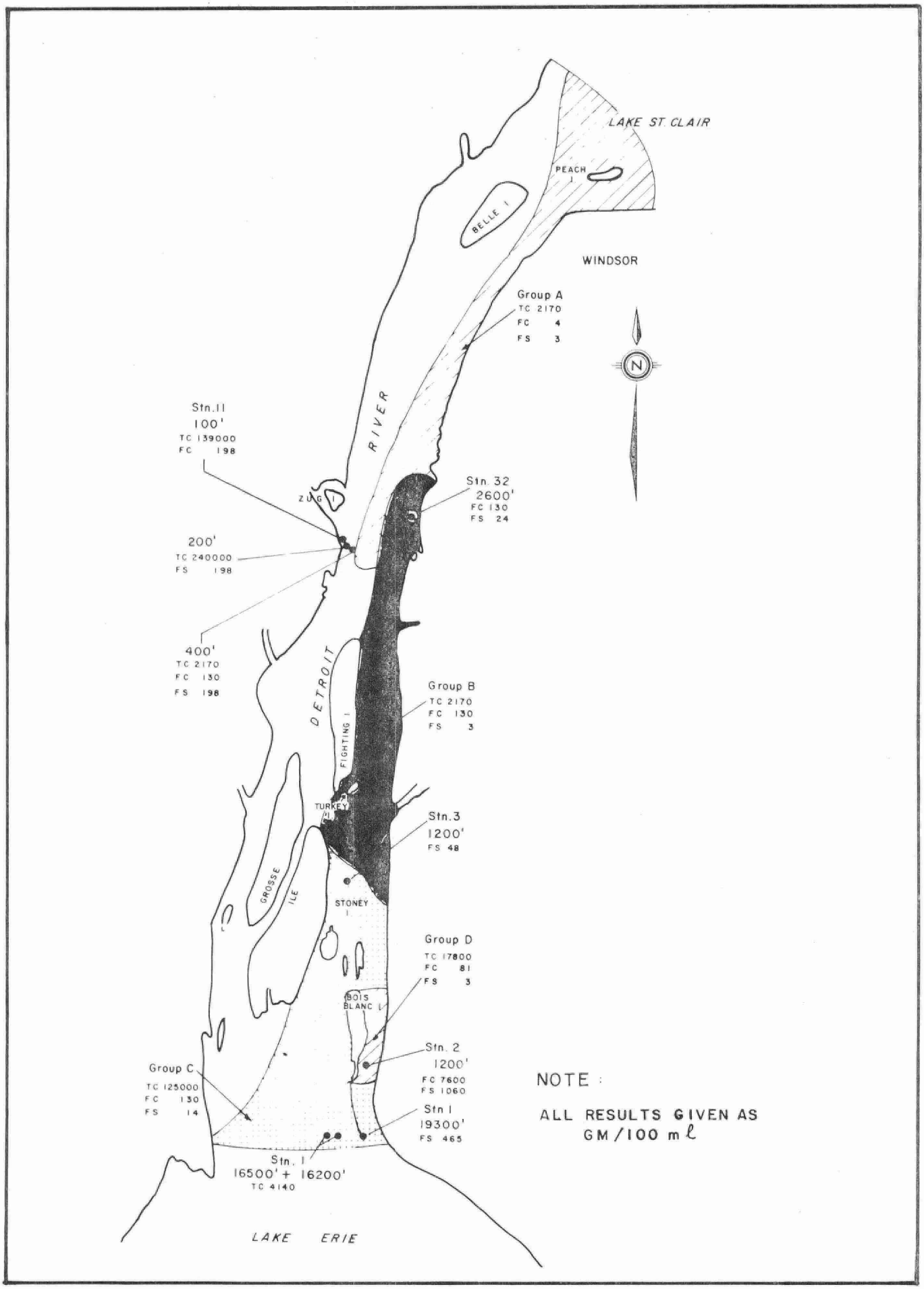


FIGURE 5 : DETROIT RIVER SURVEY – AUGUST, 1973

The worst conditions were found to exist at the southern end of the River from Grosse Isle to Lake Erie. During August TC and FC recoveries were 125,000/100 ml and 130/100 ml, both above the Recreational Use Criteria. TC was also above the Public Surface Water Supply Criteria, FS levels in this same area were 14/100 ml. These TC levels were significantly increased over June levels, while the FC levels were lower and the FS densities showed no significant change. The FC/FS ratio still indicated pollution from human fecal waste.

To further assess the water quality of the Detroit River, graphs were prepared (FIG.6-14) of bacterial levels at the stations closest to the Canadian shore. The y-axis is a log scale showing the geometric mean bacterial densities while the x-axis shows the relative positions in miles of the different sampling ranges upstream from Lake Erie. Separate graphs were prepared for each parameter for each study with GM levels plotted for the two sampling points, at each range, closest to the Canadian shore.

These plots demonstrated that conditions were generally consistent along the Canadian Shoreline with a slight increase occurring through the length of the river. In general bacterial levels were above Recreational Use Criteria.

In May a large decrease in bacterial densities was detected at range 32. This sharp decrease was inconsistent with the general trend and may have been due to an input of toxic materials.

During August an increase in parameter levels was noted south of the Amherstburg sewage treatment plant, possibly due to treatment problems at the plant.

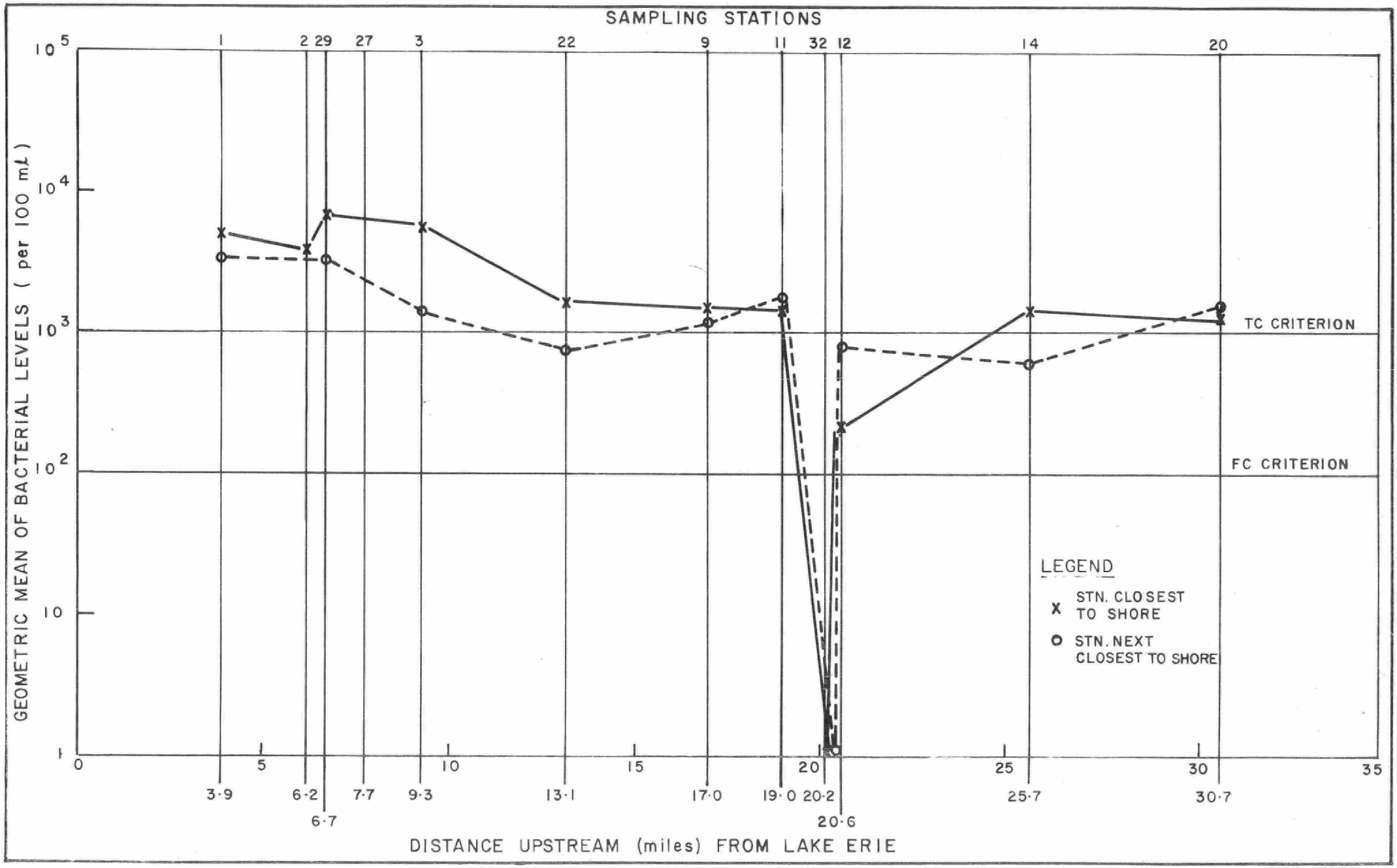


FIGURE 6 : DETROIT RIVER 1973 — LEVELS OF TOTAL COLIFORMS DURING MAY AT STATIONS CLOSEST TO AND NEXT CLOSEST TO THE CANADIAN SHORELINE

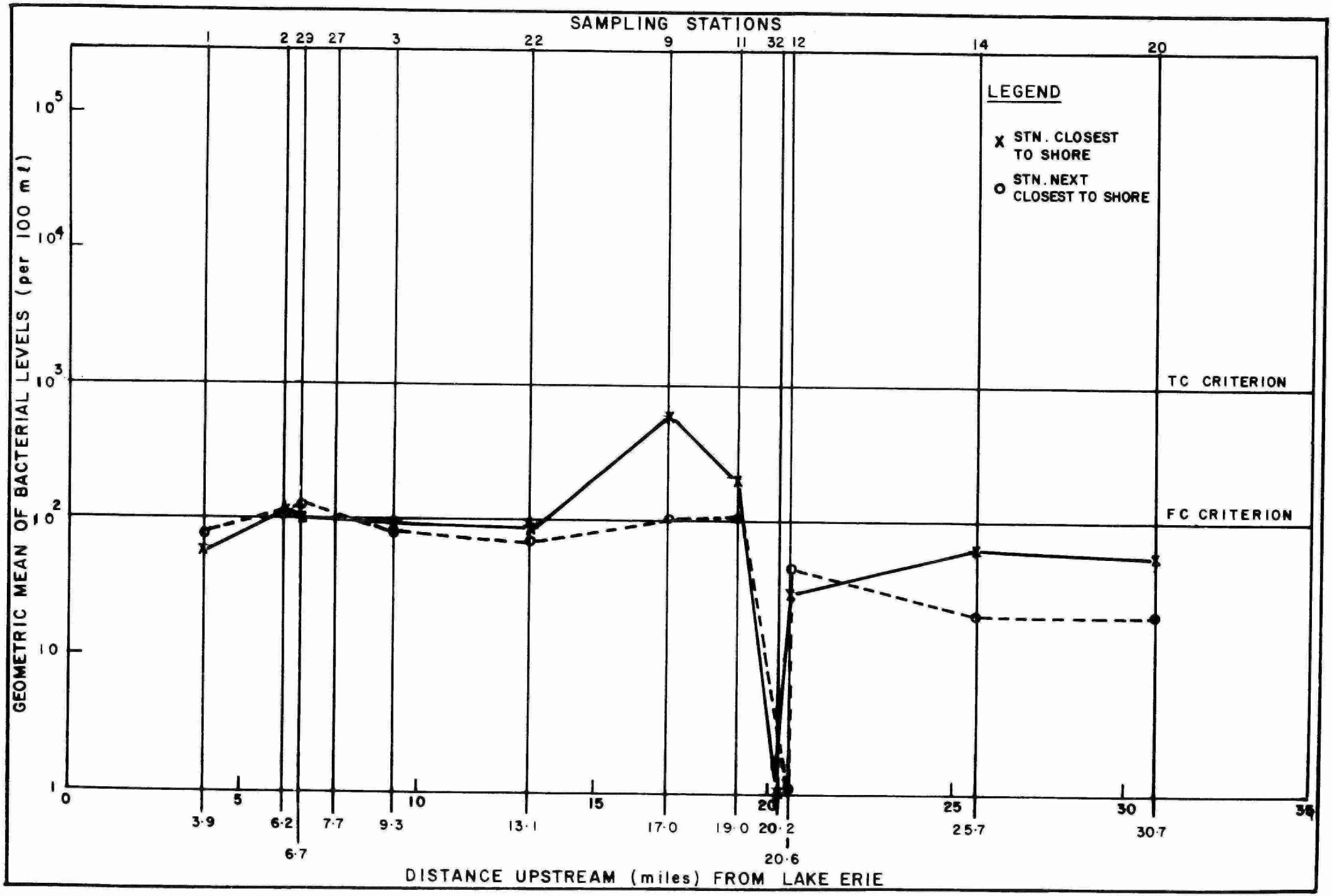


FIGURE 7 : FECAL COLIFORM MAY, 1973

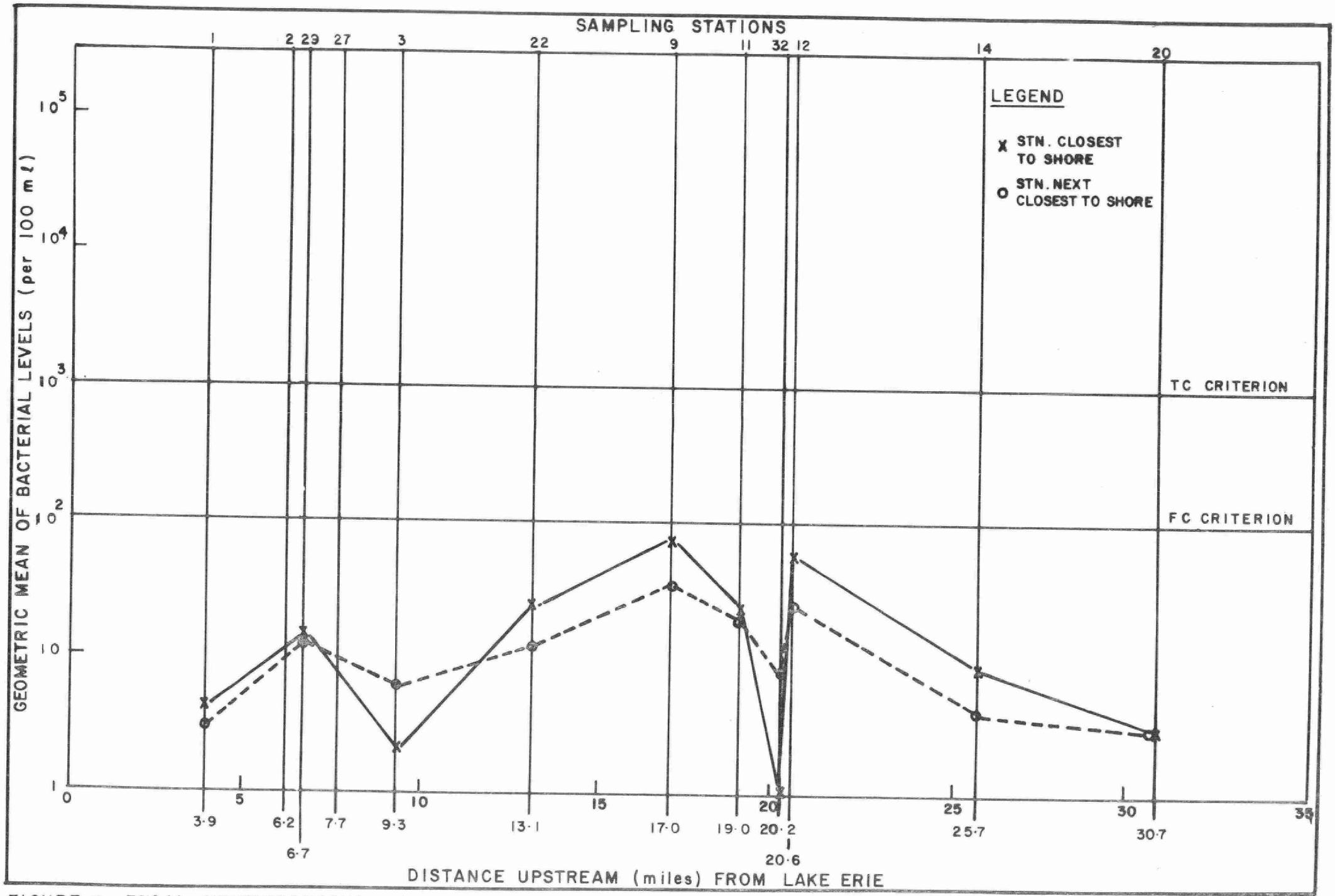


FIGURE 8 : FECAL STREPTOCOCCUS MAY, 1973

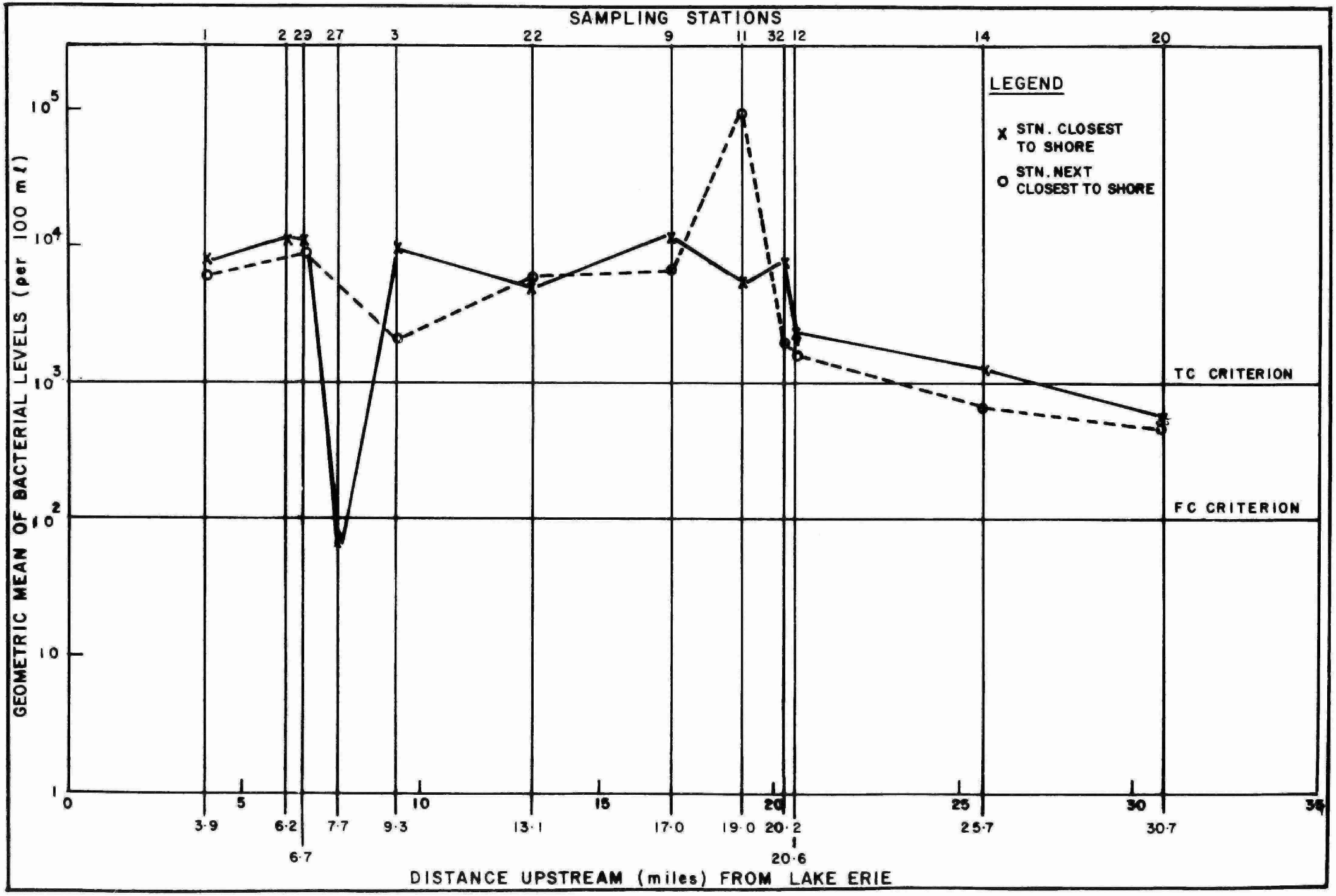


FIGURE 9 : TOTAL COLIFORM JUNE, 1973

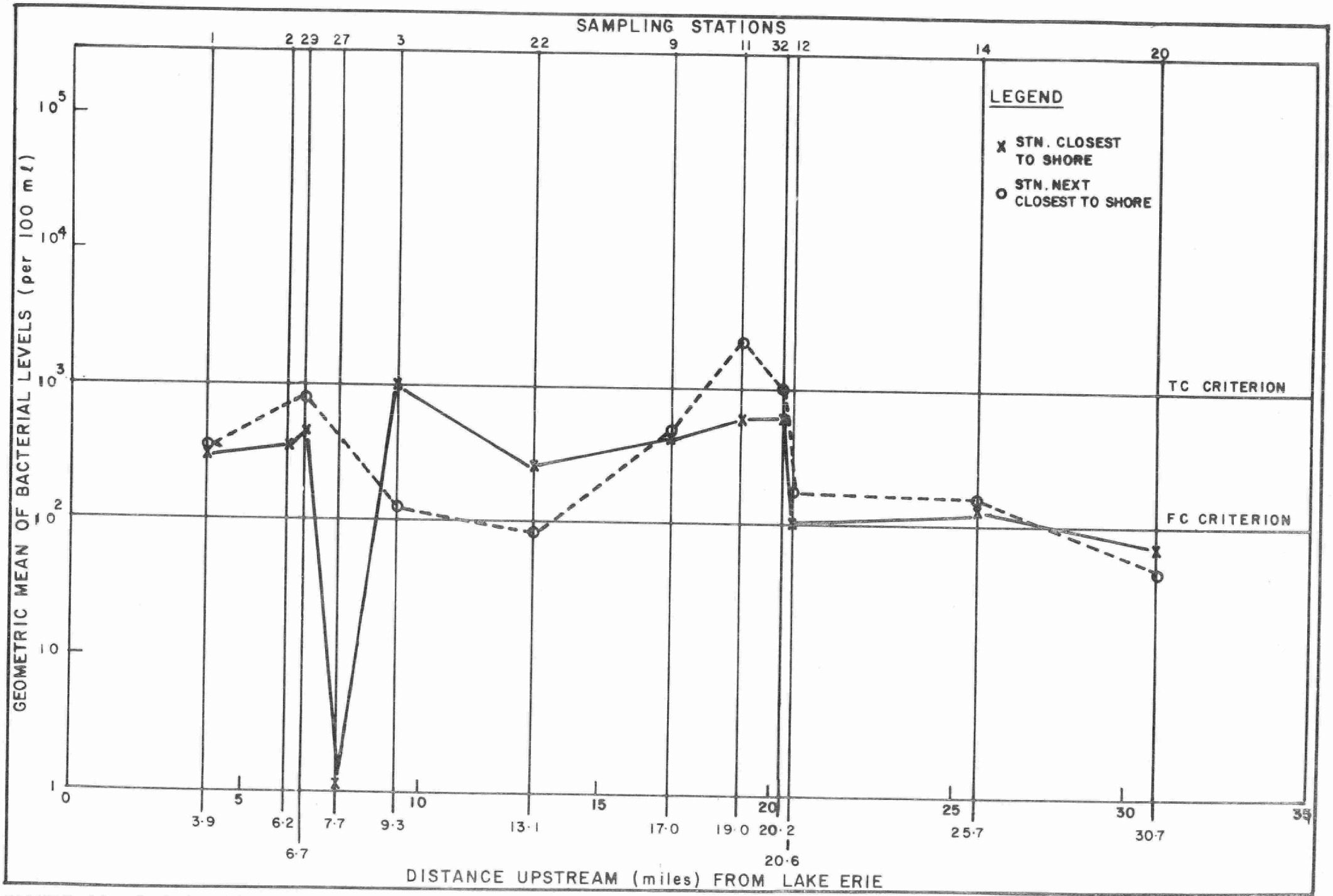


FIGURE 10 : FECAL COLIFORM JUNE, 1973

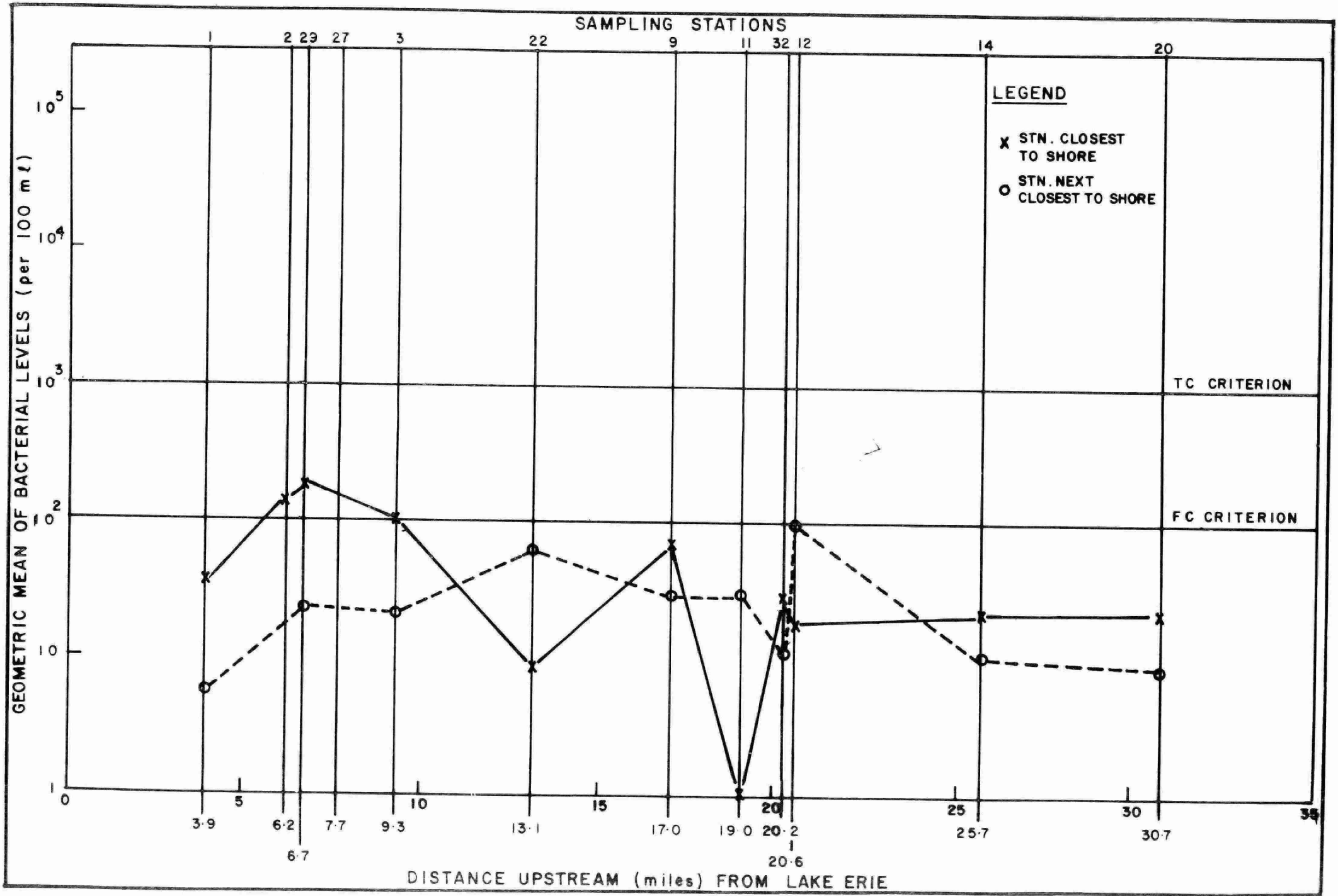


FIGURE 11 : FECAL STREPTOCOCCUS JUNE 1973

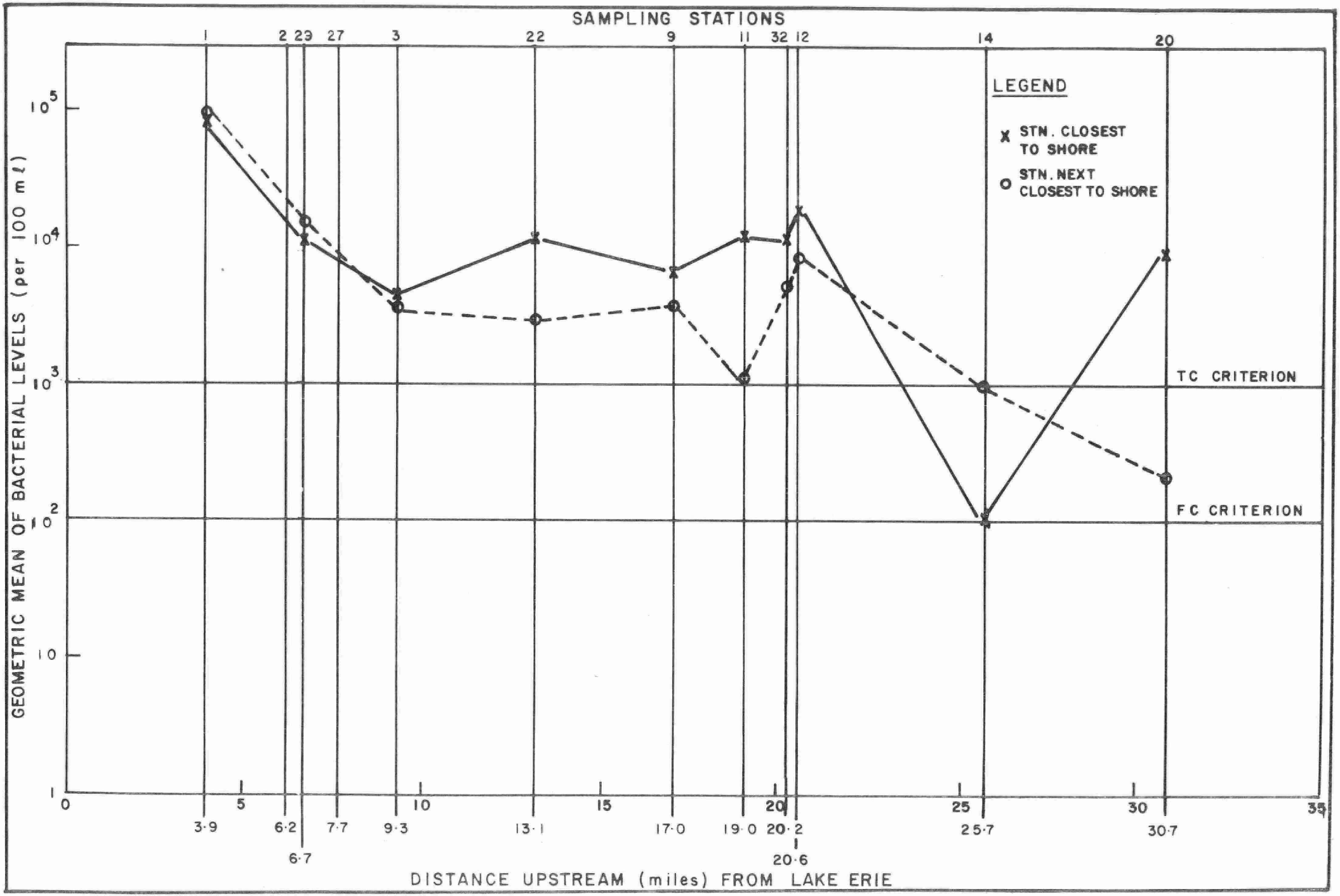


FIGURE 12: TOTAL COLIFORM AUGUST, 1973

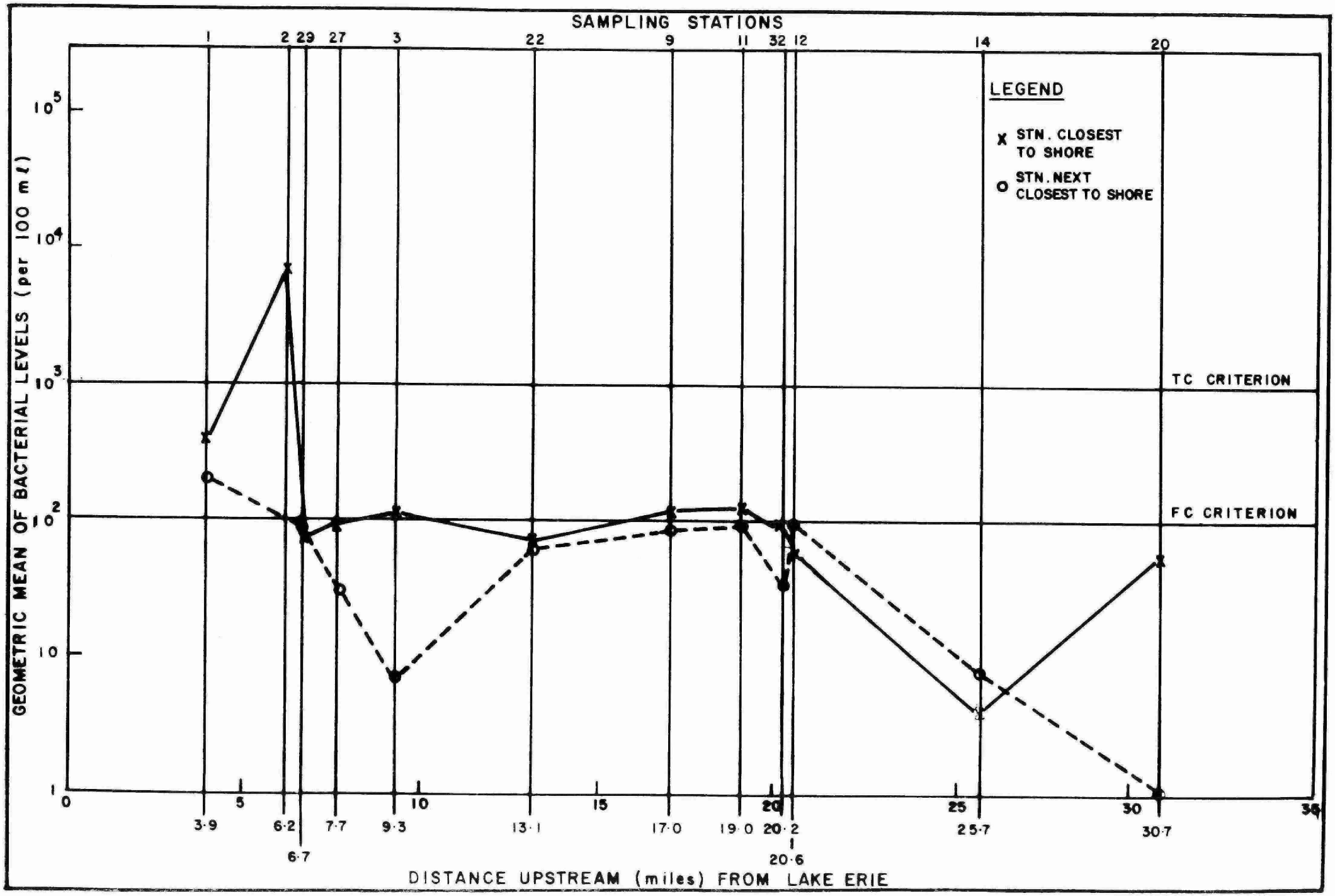


FIGURE 13 : FECAL COLIFORM AUGUST, 1973

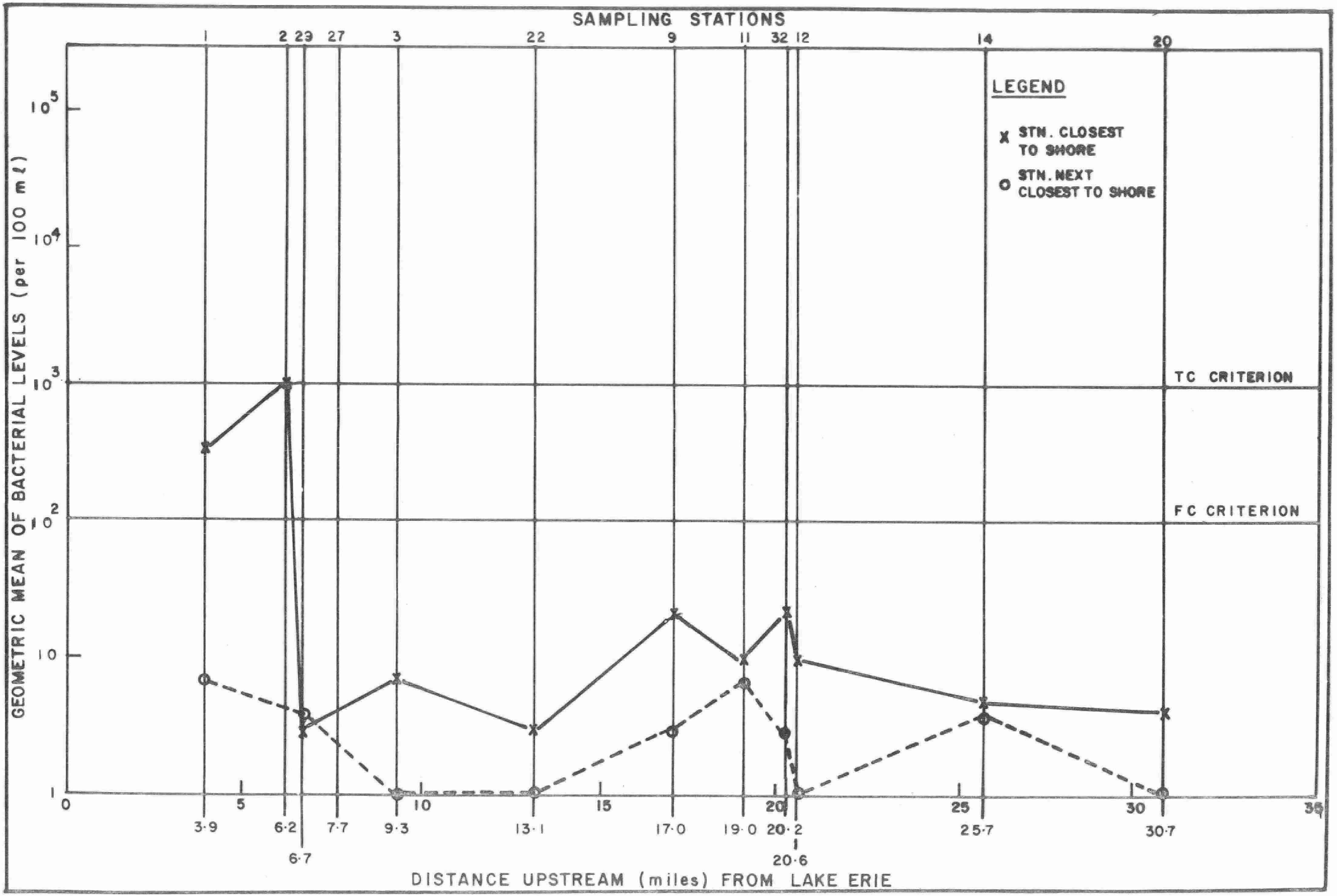
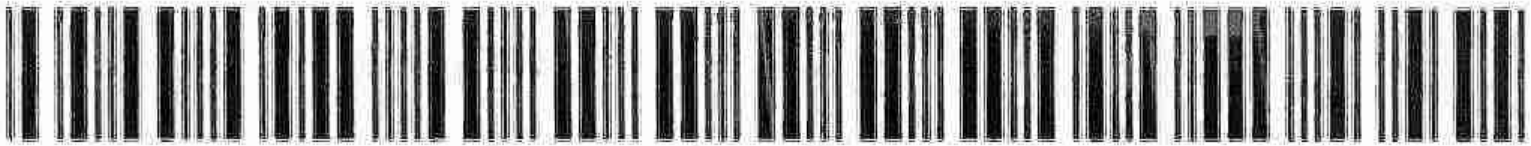


FIGURE 14 : FECAL STREPTOCOCCUS AUGUST, 1973

The results of these studies indicate that the Detroit River is heavily polluted bacteriologically. TC levels were found to exceed the Recreational Use Criteria, throughout most of the area sampled, in all three studies, while FC levels exceeded the criteria in June and August. The high percentages of sampling points with FC/FS ratios above 4.0 indicates that a great portion of the river has been affected by fecal waste inputs of human origin.

Based on the preceeding data, body contact recreation in the Detroit River may prove hazardous to health and should therefore be avoided.

With regard to public surface water supplies the FC and FS levels in the river remained below their respective permissible criteria during all studies. The TC levels, however, were found to exceed the Public Surface Water Supply Criteria throughout most of the river during the June study and at the southern end of the river in August. It must therefore be recommended that close surveillance of the water supplies and finished water be continued to exclude the possibility of any public health threat.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